Natural Science

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NOTES AND COMMENTS.

Ornithological Amenities.

MR. EAGLE CLARKE, whose work on bird migration has won for him a high reputation even beyond the wide circle of ornithologists, relates an interesting though deplorable experience in a recent paper on "Ushant as an ornithological station" (*Ibis*, April 1899, pp. 246-270). Ushant appeared to him to lie not only at the diverging point where all those migrants which traverse the southern (French) shores of the Channel and the western coast of France change their course to proceed east or south, according to the season, but also to lie in the course of those birds of passage which, having skirted the western and southern coast-lines of Britain, take their departure from our south-western shores and wing their way northward to their winter-quarters, reversing this route in spring. In other words, Ushant is "an islet amid the two main streams of that vast tide of migrants which flows northward in the spring, and ebbs southward in the autumn, along the shores of western Europe." Nothing appeared to be known concerning the island ornithologically, and it was therefore natural that Mr. Eagle Clarke and his friend Mr. T. G. Laidlaw should have looked forward with expectation to their visit to the island.

As a matter of fact, a remarkable and unexpected experience awaited them, which compelled them to fall back on Alderney. We shall let Mr. Eagle Clarke tell his story.

"At Ushant we had hoped to remain for several weeks, but we had barely been six days on the island when an immigrant in blue and white arrived: to wit, a sergeant of gendarmes (there are no police on the island). He incessantly dogged our footsteps at close quarters during our rambles, while our place of abode was under his surveillance early and late; and although we were not disposed at first to take any notice of his presence, the espionage at length became so intolerable that we reported the matter to the British Consul at Brest, and requested him to protest to the French authorities against the vexatious treatment to which we were being subjected. This the Consul most obligingly did, but his efforts were unavailing, for the authorities

informed the Consul that the gendarme had been sent to watch us by instructions from Paris.

"By the advice of the Consul, in order to escape from more serious unpleasantness, we quitted the island on the 17th of September and returned to Brest. Thus was our Ushant expedition wrecked.

"It may be well to state here that our Foreign Office had informed the French Government about our intended visit to Ushant, and its object, long before our advent on the island. Thus the treatment meted out to us is inexplicable."

Some weird light on the misadventure (though there were some results after all) is given in a footnote, which contains an extract from *La Patrie* to the effect that "the English are in the habit of visiting Ushant with a view to secure pilots well acquainted with those dangerous seas, and to bribe the islanders with British gold. Only last year, under the pretence of rewarding the islanders for their conduct in connection with the wreck of the *Drummond Castle*, they scattered a perfect golden shower over the islands. In short, our neighbours, in the time of peace, pave the way for the purchase of traitors in the time of war!" If it were not sad it would be absurd; and one cannot help feeling that though there may be diseases more fatal, there is none which can expect less sympathy than that of red-tape-worm.

Marine Zoology in Jamaica.

WE have just received the "Annual Report on the Institute of Jamaica for the year ended 31st March 1898." The museum appears to be making good progress under the curatorship of Mr. J. E. Duerden. The Caribbean Sea Fisheries Development Syndicate has investigated Jamaican waters with a steam trawler, with a view to establishing a fishing industry on a large scale. Unfortunately the scarcity of fish and the coral nature of the sea-floor militate against this plan. The operations of the trawler have been recorded by the curator; and a large series of local sponges has been contributed by the syndicate; one massive specimen is two feet across. Mr. Duerden himself has collected an almost complete series of the thirty-five known species of Jamaican Actiniaria, a group on which he has published several papers. Miss Rathbun of the United States National Museum has identified many additions to the collection of Crustacea. It may be useful to note that a 3 to 5 per cent solution of formalin has now been in use for over two years as a preservative fluid for fishes, coelenterates, and holothurians, and has preserved the natural form and colours of the animals better than alcohol. Mr. Duerden has also been investigating the relics of the aboriginal Indian inhabitants of Jamaica, and the collection of these relics has been much increased. The Report indicates a gratifying growth of interest in the museum.

An old Link between North America and Arctic Europe.

Tetradium is the name given by Dana to a Palaeozoic fossil of somewhat uncertain affinities, but apparently a coral. The presence of four septa, forming an aperture shaped like the diaper of Gothic architecture, and of grooves or rugae outside the tubes and exactly opposite the septa, are features reminiscent of the Rugosa. A certain connection of the calicular tubes through intervening lamellae induces a superficial resemblance to the chain-coral—*Halysites*. Some of the species grow in compact masses, the tubes in close contact; in others, such as *T. apertum*, the tubes are further apart and united laterally only by horizontal tubules such as occur in *Syringopora*, a genus from which it differs in all other respects.

Tetradium has hitherto been known only from the Ordovician of North America, being confined to the Trenton and Hudson River groups of Tennessee, Kentucky, Ohio, New York, and Canada. Attempts have, it is true, been made to record it from elsewhere. Nicholson and Etheridge described a *Tetradium peachi* from the Scottish Silurian, but it does not present the characters of the genus. Schlueter has shown that Frech's *Tetradium eifeliense* is only a *Calamopora*. Last year, however, Professor A. G. Nathorst brought back from Beeren Eiland, near Spitzbergen, fragments of limestone in which Professor Gustaf Lindström has detected a *Tetradium* indistinguishable from *T. apertum*, Safford. He describes and figures it in *Öfversigt af k. Vetenskaps-Akademiens Förhandlingar*, 1899, No. 2. This both extends the geographical range of the genus and proves the existence of Ordovician limestone on Beeren Eiland.

The Artillery of the Bombardier Beetles.

The ejection of an acid fluid, which explodes and vaporises in contact with the air, from the tail-end of carabid beetles of the genus *Brachinus* is well known to entomologists. It seems to serve as a valuable protection against the pursuit of larger members of the family. Dr. L. Bordas has recently (*Zool. Anzeiger*, xxii. pp. 73-76) studied the apparatus to which this secretion is due. A pair of glands, consisting of bundles of lobules, are situated on either side of the intestine beneath the dorsal body-wall; from these lead long, coiled efferent ducts, which are remarkable for the narrowness of their internal diameter and the great thickness of their circular muscle-layer which is arranged in a series of annular discs. Each duct opens into a large reservoir, whence an ejaculatory duct arises to open

a little above and behind the anus. Both these ducts and the reservoirs are lined with chitin and evidently formed by invagination of the ectoderm. The likeness of the discharge of these beetles to that of artillery is increased by Dr. Bordas' observation that after dark the emitted vapours show a phosphorescent light.

Economic Entomology.

WE have received Miss Ormerod's twenty-second report on Injurious Insects, and notice with satisfaction that a general index to her whole valuable series is in course of preparation by Mr. R. Newstead of Chester, who has undertaken to collaborate with her in the preparation of a second series of reports. In these a special feature is to be the utilisation of short notes on means of prevention and remedies, which may be furnished to Miss Ormerod by her correspondents, less space being devoted to descriptions and figures of insects already well known. Among less familiar pests mentioned in the present Report are the gall-midge, *Diplosis pyrivora*, Riley, whose maggot feeds within pears, causing a stunted and aborted growth; and the "rustic" moth *Hydroecia micacea*, Esp., whose caterpillar bores into potato stems.

From the U.S. Department of Agriculture, we have received Part 6 of the Bibliography of American Economic Entomology, comprising titles of publications from June 1888 to December 1896. This work will tell the student of insects of many papers which do not gain notice in the ordinary zoological bibliographies.

The latest bulletin (No. 19) of this Department is by Mr. F. H. Chittenden and deals with some insects injurious to garden and orchard crops. Of considerable biological interest is the ladybird beetle, *Epilachna borealis*, Fb. Unlike most of its family this insect is a vegetarian, and feeds largely, both in the larval and perfect stages, on the leaves of "squash" and pumpkin. It has the curious habit of marking out a circular area on the leaf within which it eats. A hemipterous insect (*Anasa tristis*, D. G.) which feeds on the same plants, and another (*A. armigera*, Say) which devours cucumber leaves, are carefully traced from the egg through five nymphal stages.

Mr. M. V. Slingerland of the Cornell University, Ithaca, N.Y., contributes to the *Photogram* (vol. vi. pp. 141-145) an instructive article on the application of photography to economic entomology. A want of definition in detail is often to be noticed in photographs of insects, but Mr. Slingerland's methods seem to give remarkably clear pictures. "Long exposures with all the light it is possible to get" and "a slow-developer" are recommended for the best results, and in many cases the use of a yellow ray filter greatly increases the effect.

The Royal Society's Conversazione.

THE first of the two annual conversaziones of the Royal Society was held on May 3. Among the exhibits of special interest to our readers the following may be recorded:—

The tsetze fly committee of the Royal Society exhibited enlarged photographs, taken by Surgeon-Major Bruce, illustrating districts in South Africa affected by the tsetze fly disease.

Prof. J. Norman Collie showed some fine photographs taken during a journey of exploration to the sources of the Athabasca and Saskatchewan rivers. The chief result of the expedition was the discovery of the largest snow-fields and highest peaks at present known to exist in the Canadian Rocky Mountains.

Mr. Saville-Kent showed some lantern slides of various zoological and botanical subjects reproduced in their natural colours by photography, prepared from negatives taken through screens corresponding in tint with the three primary colours of the spectrum—red, green, and blue-violet—as first suggested by the late Prof. Clerk Maxwell, and since adopted in the colour-photography researches and inventions with which the names of Ives, Joly, Lippmann, Lumière, and others are associated. The positives from the foregoing negatives are printed as three-film or glass transparencies, each of which is tinted with the colour complementary to that of its respective negative; they are then superimposed in correct register.

Messrs. J. E. Barnard and T. A. B. Carver demonstrated an elaborate photomicrographic apparatus for high powers, designed for the Jenner Institute of Preventive Medicine. To secure rigidity among the several components the apparatus is upon a stiff girder; which, in extreme cases, may be suspended by springs to isolate it from a source of vibration. The apparatus is arranged for use with transmitted light, but the illumination of opaque objects is provided for by a prism carried upon a jointed support above the stage, the arc lamp and condenser having sufficient range to allow the beam to be thrown in a line parallel to and above the line of collimation of the microscope. A useful feature is the graduation of the slides upon which the components move; thus the conditions under which any photograph is obtained may be recorded and reproduced. The length and rigidity of the apparatus permit of very great magnification without blurring. Valuable results have already been obtained with this, especially when aided by the differentiating action of monochromatic illumination.

At an adjoining table were to be seen numerous microscopic preparations of mosquitoes, exhibited by Dr. P. Manson and Surgeon-Major Ross, to show the development of the malarial parasites, *Filaria nocturna* and *Proteosoma grassii*.

Dr. G. H. Fowler exhibited various floating organisms obtained by him on board H.M.S. "Research" from the Faeroe Channel. The deep-water forms were taken by a net made to open and close when desired; they came from various depths down to 500 fathoms, the temperature being in some cases as low as 30° Fahr. Of chief interest were some beautiful specimens of Phaeodarian Radiolaria, notably *Coelodendrum murrayanum*; these confirmed the wonderful drawings of Haeckel. It was curious to see among the salt-water captures an example of that parasite of fresh-water fish—*Argulus foliaceus*. Another noteworthy occurrence was that of some shallow-water Arctic forms found in the cold deep waters of the Faeroe Channel.

The Marine Biological Association attempted to illustrate the methods of feeding of marine animals by a series of selected animals from the neighbourhood of Plymouth. One or other of the following means is usually adopted: (*a*) the production of currents by either ciliary or muscular action; (*b*) the prehension of moving prey either by special organs provided with pincers, suckers, or nematocysts, or by teeth and jaws; (*c*) browsing upon or sucking in nutritive material, either living or dead. The Association also showed charts illustrating the distribution of the fauna and bottom-deposits near the 30 fathom line from the Eddystone Grounds to Start Point.

The collections made by Mr. C. W. Andrews in Christmas Island, and those more recently brought by Dr. H. O. Forbes and Mr. W. R. Ogilvie Grant from Socotra, attracted much attention; but to these we have previously alluded.

The skin of *Neomylodon* was exhibited by Dr. F. P. Moreno, who also showed a plaster reproduction of the skeleton of *Toxodon platensis* (see *Natural Science*, vol. xiii. p. 290), as well as many skulls of other extinct mammalia from Patagonia and Argentina.

Dr. H. Sorby advocates the use of strong glycerine for preserving the more translucent marine animals in museums. It makes the colours of the surface bright and renders much of the internal structure distinctly visible. Menthol is used by him to kill sea-anemones and similar marine animals, since the addition of a little to the sea-water in which the animals are living causes them to expand fully, and in many cases to die so displayed. They may then be transferred to 4 per cent formalin, and kept thus distended or mounted in balsam as lantern slides. Some of the latter were exhibited and commented on by Dr. Sorby.

Another short lecture was that by Mr. R. Kearton, who with Mr. C. Kearton has taken such admirable photographs of our native birds in their natural haunts.

Professor Arthur Thomson of Oxford considers that three factors are concerned in the production of curly hair: (1) the hair shaft, (2) the hair muscle, and (3) the sebaceous gland. Straight hair is always

circular in section, and is usually thicker than curly hair, which is ribbon-like and fine. In order that the muscle may act as an erector of the hair it is requisite that the shaft of the hair embedded in the skin should be sufficiently strong to resist any tendency to bend; unless this be so the lever-like action necessary to produce its erection is destroyed. When the hair is fine and ribbon-like, the shaft is not sufficiently stout to resist the strain of the muscle and naturally assumes a curve, the degree of curvature depending on the development of the muscle, the resistance of the hair, and the size of the sebaceous gland. The curve thus produced becomes permanent and affects the follicle in which the hair is developed; the softer cells at the root of the hair accommodate themselves to this curve, and, becoming more horny as they advance towards the surface, retain the form of the follicle; the cells on the concave side of the hair are more compressed than those on the convex side. In this way the hair retains the form of the follicle after it has escaped from it. Professor Thomson illustrated his views by a working model, but did not imagine that his ingenious mechanism could be applied to the human scalp.

Essex and East Anglia.

We have received Volume X. of the *Essex Naturalist*, and find that in it the praiseworthy traditions of the Essex Field Club are continued. The volume contains the contributions for the years 1897 and 1898. Since we cannot allude to all of them, we may select as among the more important the various papers on recent and Post-pliocene mollusca by W. M. Webb, A. S. Kennard, and B. B. Woodward, and "The Entomostraca of Epping Forest," by D. J. Scourfield. As these and other papers witness, this club wisely restricts its energy to its own field, the natural history of the county of Essex, thus eliciting from its members work of real value and cultivating that healthy local spirit which is the best preparation for national and international co-operation.

Such co-operation is already proposed. At a largely attended meeting at Witham, on July 23, 1898, the question of federation of the East Anglian Natural History Societies, previously ventilated by Sir Francis Boileau, Mr. G. S. Boulger, and others, was definitely put forward by Mr. W. Cole, the secretary of the Essex Field Club. It was unanimously resolved that there should be an annual conference of the East Anglian Societies, on the lines of that of the South Eastern Union to which we have so often referred. The first conference is to be held this year. The opinion was strongly expressed that one of the most valuable results to be looked for from such co-operation would be the establishment of a single natural history journal for the whole of

East Anglia. From the faunistic and geological points of view the counties of Norfolk, Suffolk, and Essex have much in common, and the concentration of all records in one periodical publication would be a gain to local field-workers, as well as to the weary student in the library. Such a body as the East Anglian federation would arouse more interest in natural science, would attract more members, would obtain more money, and would be listened to with greater respect than any local society however energetic. Mr. Cole, in his paper, alluded to several lines of activity in which such a federation could do good work. One such is the establishment of a biological station, and this suggestion has been welcomed warmly. Now there are already a fair number of marine biological stations around our coasts; but where this country falls behind so many others is in the absence of a fresh-water station. The broads of Norfolk offer an admirable field for the systematic study of fresh-water life, and we earnestly hope that the East Anglian naturalists may see their way to found such a station as we have long advocated.

The Essex Museum of Natural History.

THIS is another matter in which the Essex Field Club is doing good service. This museum must not be confused with the charming little Epping Forest Museum of which we have previously given some account. It is a far bigger affair and covers a wider field. The Club has long had a museum of county natural history at Chelmsford, but it was found impossible to carry this on in an adequate manner without financial aid. This was sought at Chelmsford from individuals, from a local society, and from the Corporation, but in vain. In June 1897 the Corporation of West Ham was approached, and in July 1898 an agreement was entered into between that body and the Essex Field Club. Towards the £6000 needed for building and site, Mr. J. Passmore Edwards contributed £2500, thus removing the only serious difficulty, and on October 6, 1898, he laid the foundation stone of what is to be called the Essex Local and Educational Museum of Natural History. The museum, designed by Messrs. Gibson and Russell, will ultimately be a very handsome structure, adjoining, but distinct from the Technical Institute of the West Ham Corporation in the (Main) Romford Road, Stratford. The balance of the cost, and the upkeep of the building will be defrayed by the Corporation of West Ham.

The promoters of this museum have availed themselves to the full of the experiences of others, and their scheme for the maintenance of the institution may serve as a model. This is shown by the following extracts from the statement and appeal now being circulated.

"The Corporation agree to dedicate the main portion of the building to the purposes of a Museum of Local (Essex) Natural History, Pre-Historic Archaeology and Anthropology, and of Educational series relating to the same; to warm, light, and provide for the caretaking of the building; that the Club shall have the sole scientific control of the collections and the appointment of the curator, and be allowed to keep its library in the building; the Corporation also agreeing to make a grant of not less than £100 per annum towards the curatorial expenses. The Club agree to place their county collections, cases, and cabinets in the Museum (excepting the Epping Forest collections, which are to be retained in the Forest Museum at Chingford); to do their best to increase and improve the same; to undertake the selection and scientific control of the collections; to raise a certain capital sum for the further equipment of the museum; to appoint a curator, and to devote a sum of £50 per annum towards the curatorial expenses." Thus there is assured an annual income of £150 for that most important part of a museum—the curator. "The museum will be a Local (Essex) one, supplemented by short series having an educational value, and designed to show the place of the local forms in the general scheme of classification of animal and vegetable organisms. The promoters aim at its eventually fulfilling three main purposes: (1) The instructive recreation of the ordinary visitor by means of carefully arranged sets of the chief forms of life inhabiting the district, and examples showing the nature and meaning of fossils and geological formations; (2) assisting students and field-naturalists in identifying and studying the groups in which they are interested; (3) collecting and preserving authentic series of all forms of life, recent and extinct, occurring in Essex, as well as geological and anthropological specimens. This is a matter of really great scientific importance in view of the changes in our fauna and flora now so rapidly being brought about by the increase of population and the consequent effacement of natural conditions in many parts of the country." This scheme will be adhered to rigidly. Incongruous miscellanea and donations saddled with conditions will be sternly rejected. On the other hand, there will be systematic and organised collecting. "In addition to the sets now in the possession of the Club, valuable collections have already been promised for the new museum, including a Herbarium of Essex plants, a large collection of fossils and rocks for the educational series, and a collection of the Crag fossils. Also a collection of the Pleistocene Mammalian fossils and sets of the Lepidoptera and Coleoptera of the county, etc. The main difficulty lies in the provision of suitable cases and cabinet accommodation for the collections, and the classification and arrangement of the same, which will entail a very considerable expenditure of *money* and *time*." This latter is the part of the Essex Field Club, which desires to raise for the purpose £1000, and has therefore started a "Museum Purchase

Fund" to which donations are solicited from all interested in the spread of natural science and of popular education. Donations may be paid to Lloyd's Bank (Essex Field Club Account—Town Side), 72 Lombard Street, E.C.; or to the Treasurer, W. C. Waller, Esq., Loughton, Essex. A point to which *Natural Science* has often drawn attention should be noted: "Under the agreement, should the Club at any future time be unable or unwilling to continue to control the museum, it will revert to the Corporation, to be by them maintained and managed precisely on the lines laid down in the agreement. This stipulation gives a warrant of permanence to the museum—a matter of the utmost importance."

It is hoped that the museum may be opened to the public in the spring of 1900.

Nature-Study.

WE are pleased to observe the regulation in the code of the Scotch Education Department for 1899 recommending the teaching of Nature Knowledge, and this on the basis of regional survey. This change has come as a surprise to teachers, but opportunities to prepare for it are already beginning to be offered them by educational authorities. In the past the only regular means available have been the museums and informal general excursions of the various local natural history societies, or the occasional school expeditions conducted by every effective science teacher. Among more organised efforts may be mentioned those of the School Board of Dunfermline with the help of Mr. Henry Beveridge of Pitreavie, who have for several years past arranged regular series of school excursions throughout the main centres of natural, historical, or social interest. These were at first conducted by Dr. Herbertson and Mr. T. R. Marr, and since by Mr. Robert Smith, B.Sc. During the past few years also the County Council of Perthshire has been specially active in organising central classes for the training of teachers in Physical and Natural Science, and the movement seems in a fair way to obtain fuller scope. One example of the quickened interest is to be seen in the trebling of the number of teachers attending the evening Botany Class at University College, Dundee.

In the same connection we note that Mr. Henry Coates of Perth has recently granted prizes to the best essays written by Perthshire school children on a visit to the admirable museum of the Perthshire Natural History Society. The essays were corrected by Mr. W. J. Calman, B.Sc., whose report, though at the same time encouraging, shows the very urgent need of a systematic extension of this mode of utilising local museums in school education; and of the necessity of teaching both child and teacher alike what and how to observe.

Fishing at the Cape and elsewhere.

THE fishing industry at the Cape of Good Hope is passing through its life-history more rapidly than at home. Here we are well on in the stages of metamorphosis, and at the Cape the larval stage is just coming to an end. To be plain, the method of catching fish by a trawl has caused a rude awakening amongst the seafaring folk who, with the primitive methods of open boat and hand-lines, have been wont to supply the market to their own advantage. As in 1883 in Scotland, so in 1898 at the Cape, a Select Committee on the fishing industry sits to hear the same old "chestnuts" of destruction by the trawl of the fish-spawn, of fish-food, and of nearly everything else in the sea, but fortunately in the former case scientific knowledge was forthcoming, whereas in the latter the scientific voice seems to lack decisiveness.

Dr. Gilchrist, the Government Marine Biologist, states in evidence that "we know absolutely nothing about the spawn of the fish." This statement seems to require some explanation, considering that the author of it has been over three years in Cape waters, and that an experimental trawler at an initial outlay of £7000 and an annual expenditure of "between £3000 and £4000" has been placed at his disposal. From a distance it seems as if it should have been possible by this time to make sure of the leading facts relating to the spawning of nearly all the commonest food-fishes of the Cape.

Turning our attention to New South Wales we find the fisheries at an equally early stage of metamorphosis. Trawling experiments, as recently in Jamaica, are being conducted with a view to the introduction of this method of fishing into the colony. The experiments, unlike those in the West Indies, were distinctly successful. Mr. Frank Famell is to be congratulated upon an enterprising attempt to show the possibilities in this direction. His report is accompanied by a valuable and concise report upon the fishes which were obtained, drawn up by Mr. E. R. Waite. He describes a new species of Chimaera (*C. ogilvyi*) and of boar-fish (*Histioptuus famelli*), besides being enabled to definitely locate such types as the ordinary flying-fish. The six weeks' trawling cruise of H.M.C.S. "Thetis" opens up great possibilities for the Australian fisheries, but if there is a strong contingent of line fishermen on the sea-border of New South Wales Mr. Famell must be prepared for the inevitable consequence!

A short report upon the fish-fauna of Long Island has an interesting series of observations upon the attraction of fishes by lantern light. Three hundred and forty-eight species of fishes are now known from the New York district, of which one hundred and sixteen are from the fresh waters, and thirteen are anadromous in habit.

Development of Lepidosiren.

A VALUABLE contribution to our knowledge of the Dipnoi will be found in Mr. Graham Kerr's paper on the external features in the development of *Lepidosiren paradoxa*, Fitz., communicated to the Royal Society, May 4. The abstract with which we have been favoured summarises the more important points as follows:—

The egg is very large, 6·5 to 7 mm. in diameter. It is surrounded by a special capsule, at first thick and almost jelly-like in appearance, later on (after fertilisation) thin and horny. Outside this was found in rare cases a thick jelly resembling that of the frog's egg. The egg is without a trace of dark pigment. Segmentation is complete, resembling most nearly that of the egg of *Amia*, and leads to a condition with an upper hemisphere of small cells with large segmentation cavity, and a lower of large yolk cells. Gastrulation begins with the appearance of a row of depressions, or a continuous groove along about one-third of the whole extent of the margin between small and large cells. During its progress the small-celled portion spreads over the lower yolk cells by the addition to its margin of small cells split off from the yolk cells. As the groove referred to deepens into a slit to form the archenteron, it becomes gradually shorter, and the eventually complete blastopore is a crescentic slit only about a quarter of the length of the original groove. The medullary folds soon appear running forwards from the blastopore. There is no trace externally of a blastoporic or protostomal seam running along the back between the medullary folds. The folds are low and inconspicuous, and they are continued into one another behind the blastopore, which becomes the anus. There are only slight traces of overarching of the medullary folds to enclose a neural canal. During the later stages of intraoval development, the posterior end of the body becomes much more conspicuously folded off the yolk than the head end. The *Lepidosiren* hatches out as a tadpole-shaped larva, still completely devoid of dark pigment. Just about the time of hatching the cloacal opening closes temporarily. As the larva develops it becomes extraordinarily amphibian-like. It possesses large pinnate external or somatic gills, four on each side, corresponding to branchial arches I., II., III., and IV. A large cement organ is also present, which during its early stages is of the characteristic crescent shape so usual in the embryos of Anura. Pigment begins to appear about ten days after hatching—first in the retina, then over the dorsal surface, especially anteriorly. The larval condition lasts during the first six weeks after hatching. Towards the end of this period the cement organ undergoes atrophy. The somatic gills atrophy later. During the process of their doing so, the *Lepidosiren* passes through a condition in which the stumps persist, evidently corresponding to that well known in the young *Protopterus*, the group of external gills with their common stalk having come to be situated

immediately above the fore limb. After the close of the larval period the *Lepidosiren* becomes much darker in colour and more lively in its movement. Young were obtained from the nest up to a length of 60 mm. About this time the cornea begins to assume the white unhealthy appearance that it has in the adult. In the young of this size small yellow spots appear, and in the young of 90 mm. these are conspicuous. Occasional yellow blotches persist in the young *Lepidosiren* of eighteen months, but in the adult they disappear.

The segmentation approaches most closely that of Ganoids. The shortening up of the invaginating groove is considered to illustrate a process which has taken place in phylogeny in the passage from the primitive holoblastic egg to the meroblastic condition. The continuity of the medullary folds behind the anus is adduced, together with the evidence of the prolongation of the blastopore along the floor of the medullary groove in other forms (Amphibia, *Ceratodus*), as affording potent evidence in favour of the hypothesis which derives the Vertebrata from ancestral forms as primitive as the Coelentera, and possessing an elongated mouth traversing the neural surface. The occurrence of external gills in the young of three so comparatively primitive groups of Vertebrata as Crossopterygians, Dipnoans, and Amphibians, their occurrence on four branchial arches in *Lepidosiren*, and on at least the hyoid arch in Crossopterygians, and the occurrence of a probable homologue on the mandibular arch in Urodela, are taken as suggesting that these structures are organs of great antiquity in the Vertebrate stock, and that there was formerly one present on each visceral arch. It is pointed out that were this so, it would afford a theory of the origin of vertebrate limb, which would be supported by much of the evidence brought forward by the supporters of Gegenbaur's view, and which at the same time would avoid the most important difficulties in the way of this theory.

The Man in the Beast.

COMPARATIVE psychology is the most anarchic department within the naturalist's province. The reasons for this are twofold. On the one hand, the subject-matter is in great part within the reach of all, and amateurs—most delightful people as long as they retain some sense of their limitations—rush in with inaccurate observations and incompetent inferences. On the other hand, the problems are intrinsically very difficult, so that it is at present hardly possible for the most careful experts to formulate even a small number of certainties to question which might be ruled irrelevant. Moreover, there are various vested emotional and other interests which are believed to be more imperilled by opinions regarding instinct than by those regarding protoplasm. All this being so, we are not assuming any position of superiority

when we say that the department of comparative psychology is notoriously anarchic, and a happy hunting-ground for the crank whose hand is against every man's. In this there is no reason for ill-humour, except that many people are led astray from the paths of clear-thinking, and that much energy is wasted in making bad inferences which might have been more profitably expended in making good observations. The only cure that we can suggest is that it might, without tyrannous censorship, be made, let us say, a point of etiquette, that a man should not publish his views without first making himself reasonably well acquainted with what has been done and said on the subject by a few of the leading representatives of the different schools.

These remarks are prompted by the perusal of a little book entitled "The Dawn of Reason,"[1] by Dr. James Weir, Jr., author of "The Psychical Correlation of Religious Emotion and Sexual Desire," etc.; and the particular characteristic of the book which seems to call for comment is its remarkable combination of good and bad qualities. It cannot be read without pleasure and profit, for it records in an entertaining way many very interesting observations; it cannot be read without disappointment and irritation, for its inferences are prejudiced and its prejudices are ignorant. Let us illustrate.

The author tells us in his preface that "his material has been thoroughly sifted, and the reader may depend upon the absolute truth of the evidence here presented." This is admirable; evidence whose absolute truth may be depended on is exactly what we need, for, as Dr. Weir reminds us, "many of the data used by the authors of more pretentious works are second-hand or hearsay." But before we get over the third page this author tells us that he is confident that, notwithstanding the fact that the nerve-*cell* is not differentiated in the primal forms known as the monera, or one-celled organisms [we are combining two sentences], nerve-elements are, nevertheless, present in them, and serve to direct and control life. We do not see the reason for the author's confidence, but we read that his "propositions have been formulated only after a twenty years' study of biology in all of its phases." We also read that all the other senses have been evolved from the sense of touch; that the visual picture formed by a crayfish's eye is a mosaic of hundreds of little pictured sections; that the author has been able to verify Professor Clark's observations in regard to the protozoan, *Stentor polymorphus*, which, as he asserts, has a well-developed nervous system; that on one occasion, while he was studying the contractile vesicle (heart) of one of these animalcules he saw it evince what seemed to him to be unquestionable evidences of conscious determination; and so on at frequent intervals through the whole book. We must believe the author when he tells us that "his material has been thoroughly sifted," but the meshes in his sieve must

[1] New York: Macmillan Company, 1889, pp. xiii. and 234. Price 5s.

be immensely large. After waving the standard of accuracy in the preface, the author might have refrained from citing in the body of his book data "given to me at a certain club banquet where I had no facilities for noting them down."

The author's loving enthusiasm for animal life, his desire to be generous in his appreciation of its psychical aspects, and his diligence in making personal observations and experiments command our admiration, and yet, except as an emotional protest against an extreme form of the theory of animal automatism, he has spoilt his work by the common error of mixing up observation and inference. This error is so insidious that no one, perhaps, escapes uninfected by it, but our author exposes himself to it wantonly. "Time and again," he says, "I have seen a snail draw in its horns when it perceived the white ball, to it an unknown and terror-inspiring object";—the inference that the ball was terror-inspiring is unproved. "Oysters kept in a reservoir and occasionally uncovered learn to keep their shells closed, . . . this is an act of intelligence." "I also saw a spider which intentionally beautified its web by affixing to it hundreds of minute flakes of logwood-dye." The honey-making ants "have evolved the idea of setting aside certain members of the colony as honey-makers." Even a sea-anemone has acquired the habit of "letisimulation" or death-feigning, for "I reached down my hand for it, when, presto! it shrivelled and shrunk like a flash into an unsightly green lump, and appeared nothing more than a moss-covered nodule of rock." "The champion death-feigner of the vegetable kingdom is a South American plant, *Mimosa pudica*," but in this case the author allows that the death-feigning is not due to conscious determination. He is convinced, however, by actual experimentation, that his fox-terrier falls into "brown-studies," "just as man does"; and asks if the dog may not then "claim one kind of abstraction." But one more example must suffice, for our entertainment is shadowed with a feeling of sadness. "I have seen my dog chase imaginary rats around my room after having been aroused while in the midst of a dream. His chagrin when he 'came to himself' and saw me laughing was always strikingly apparent." The author should seriously consider what Huxley meant when he said "the assertion that outstrips the evidence is not only a blunder, but a crime."

The value of the book except as a warning is in the author's personal observations—if only he had given them to us untainted by inference, but the point of the book is a protest against denying intelligence to animals. "Instinct," he says, "is the bugbear of psychology, and does more to retard investigation than any other factor. As long as people of the creationist stamp wield the instinct-club, just so long will they be unable to grasp the idea of intelligent ratiocination in the lower animals." We could understand this protest if it were true that modern workers in comparative psychology believed that all animals were, as Dr. Bethe holds in regard to ants and bees,

simple "reflex-machines," or automata, as Descartes suggested; but the facts are far otherwise, as such works as those of Professors Lloyd Morgan and Groos (to cite two familiar names) clearly show. The truth is that in avoiding an imaginary Scylla, the author has been caught in a real Charybdis of absurd anthropomorphism. He reads the man into the beast, and while his generosity touches our emotions, our fondness for animals, it leaves on our intelligence an impression of the grotesque. Let us illustrate "the man in the beast." "On one occasion I made some medusae tipsy, and their drunken gravity as they rolled and staggered through the water in pursuit of the light was as sorrowful as it was instructive; their actions in this respect were those of intoxicated men." He has been led to believe that "minute microscopic organisms have their pastimes and moments of simple amusement. . . . They seemed to be engaged in a game of tag." On another occasion he observed a meeting of two snails who "bowed several times in courtly salutation." And so on the story goes.

The author "does not claim infallibility"; he "*believes*, however, that future investigation will prove the verity of every proposition that is advanced in this book. These propositions have been formulated only after a twenty years' study of biology in all of its phases." We are sorry to be compelled to point out to an ingenuous public that the author does not really know what he is talking about. "The microscope shows," he says, "that these animals have notochords, nervous systems, and ganglia, or brains. With a one-sixteenth objective, and an achromatic light-condenser, I have been able to differentiate the gray matter in the brain of an ant, and even on two occasions to bring out the cells and filaments of the cortex." This *was* an achievement, but why drag in the notochord—a piece of skeleton! Dr. Weir believes that he is the first to claim the *sensual* importance of tinctumutation [colour-change], and the sense of direction or the "homing-sense"; he is also the first to claim that instinct is "heredity under a special name." He is also the author of the following statement of his position, which it would be unfair to omit:—"Ego-knowledge, while undoubtedly present in some of the higher animals, such as the dog, monkey, horse, cat, etc., is not a factor in the psychical make-up of any of the lower animals (insects, crustaceans, molluscs, etc.). But consciousness, so far as volition or choice is concerned, enters into the *psychos* of animals exceedingly low in the scale of animal life." With this we bid farewell to a work which is appropriately called "The Dawn of Reason."

ORIGINAL COMMUNICATIONS.

The Study of Natural History[1]

By J. Arthur Thomson, M.A., *Regius Professor of Natural History, University of Aberdeen.*

It has often been pointed out that the term "natural history" is in itself an index to the progress of science. Originally it was used to include the study of the whole outer world, human affairs alone excepted. At a later date it became equivalent to what is now called "natural science," the physical and chemical sciences having specialised off. More recently it became a synonym for zoology, as apart from botany, and this remains the most frequent usage. But there is an even more specific use of the term—for the study of the life of animals as it is lived in nature, for the study of their social and family life, their habits and inter-relations, in other words, as a synonym for what some would call "animal bionomics."

It will be admitted by all that the specialising of scientific inquiry suggested by the gradual narrowing of the term "natural history" has been as valuable as it has been inevitable, for there is no one now who either would or could take all nature for his province as men like Buffon did. At the same time, it may be allowed, even by those who fully recognise the value of specialism, that the old term "natural history" strikes two notes which both teachers and students are nowadays occasionally in danger of losing.

The Unity of Science.

The first note, if I have heard it aright, suggests the unity of science. For, after all, there is but one great subject of concrete study —the order of nature; and, although we split up the study of this into sciences and sub-sciences, we are simply making an adaptation to our limited intelligence — an adaptation which inevitably becomes fallacious if it lead us to forget that, without co-operation and correlation

[1] An Introductory Address delivered at the University of Aberdeen.

of results, no permanent steps of real moment are likely to be made. This note of the unity of the sciences is sounded whenever we say the word university. Its value is demonstrated by the history of the sciences, which shows how often a fresh contact between two departments—chemistry and biology, biology and psychology—has led to great advances. It is also demonstrated when we consider a big subject, like the physiology of marine organisms, which there is no hope of understanding except through the combined efforts of chemist and physicist, botanist and zoologist. How hopeless it would be for the unaided biologist to suggest an answer to the recent question—Why is the population of swimming and drifting marine organisms denser in the arctic than in tropical or sub-tropical seas? Whether we take a hint from the way in which Linnaeus used the term "Organisata" to include both animals and plants, or from the title "Animated Nature" which the keen-witted amateur Goldsmith used, or from Comte's hierarchy of the sciences, or from the late Principal Caird's essay on the unity of science — I have purposely chosen incongruous examples—we hear the same note of unity towards which our teaching and learning must move, even if the curve be asymptotic. The study of living creatures stands midway between the chemical and physical sciences, which are in a sense beneath it, and the mental and social sciences, which are in a sense above it; there are lights from beneath and lights from above; and to attempt to shut out either means obscurity. It is evident, for instance, to every one who has considered the matter with an unbiassed mind, that what are called the evidences of organic evolution owe much of their cogency to corroborations from other sciences than biology.

The Life of Living Creatures.

The second note which seems to be sounded by the old naturalists who clung to the term "natural history"—men like Gilbert White, for instance—suggests that our first and our final problem is with the life of living creatures in a state of nature. Amid the undoubted and surely legitimate fascinations of dissection and osteology, of section-cutting and histology, of physiological chemistry and physiological physics, of embryology and fossil-hunting, and the like, do we not need to be reminded sometimes that the chief end of our study is a better understanding of living creatures in their natural surroundings? In what I may perhaps call the keenly analytic atmosphere of modern zoology there is no risk that any one will fail to appreciate the value of the abstractions which we make when we study the dead beast on the dissecting tray, or sections of parts of it under the microscope, or solutions of parts of it in the test-tube—but is there not a risk lest we forget that the picture and the problem with which the naturalist starts, and to which he must eventually return, is the picture and the

problem of the shore-pool, the wayside pond, the open sea, the moorland tarn, the bird-berg, in short, wild nature and its drama of life? Unless we get back to that we are forgetting the picture and the problem with which we start, the outlook which our eyes afford us—in other words, the facts of the case. It is this second note which I wish to catch more precisely. To show its strength and clearness, and that we may be encouraged in listening for it, I have ventured on a short statement of the problems of the naturalist, freed as far as possible from personal bias, a programme, as it were, which would be admitted by all to be in no way one-sided and yet so disposed that the value of the old naturalist's note may be made evident. I wish to suggest that natural history or bionomics cannot be either stable or progressive if it stand aloof from the results of the anatomical and physiological, embryological and palaeontological disciplines; and on the other hand, that these disciplines are to be saved from losing perspective and interest by being kept in touch with life as it is lived in nature.

The First Question—What is This?

The naturalist's first question—however learnedly he may phrase it—is one of the child's first questions, asked long before it can speak —"What is this?" In how many different tones—of fear, of awe, of wonder, of inquisitiveness—has this question been asked since man and science began! Was it not Aristotle's question when a new specimen was brought to him? was it not the question on the *Challenger*, when the dredge came up? is it not the question on the lips of every teacher and student of natural history to-day?—What is this? It is a "simple question," but how hard to answer, as we press it further and further home, from external features to internal structure, from organs to tissues, from tissues to cells, as we put one lens after another in front of our own, as we call to our aid all sorts of devices —scalpel and forceps, razor and microtome, fixative and stain. "What is this," we say, "in itself and in all its parts? what is this by itself and when compared with its fellows and kindred?" and our answer broadens and deepens till it furnishes the raw materials of the science of Morphology. Inquisitiveness is one of the prime movers of science, and one of the diagnostic characters of the scientific mood is a dislike of obscurities, of blurred vision, and of fogginess. The student who is never sure whether he sees a thing or not, who is satisfied with the ill-defined image seen through an imperfectly-focussed microscope, whose dissection is invariably like a jungle, has not the scientific rudiment in him. We must have the ideal of seeing clearly. The mole has a sort of half-finished lens, which is physically incapable of throwing a precise image on the retina. If there is any image it must be a blurred tangle of lines. To press home the naturalist's first

question—What is this?—is pre-eminently a discipline which tends to save us from having moles' lenses.

But, to be quite frank, there are few who are able to acquire the power of precise vision except within a restricted range; and even within a limited circumference the discipline is not easy. Many can sympathise with one who studied under Louis Agassiz, and relates that she was almost brought to despair by the way in which the master, having given her a specimen, came day after day, and asked her with a severe kindliness, "Well, what do you see now?" But at length she saw something—saw what was to be seen.

Those who have a strong interest in the life of animals as it is lived in nature are often keen and precise observers, but it is not always so, and the field naturalist often loses both satisfaction and effectiveness by failing to appreciate the depth of the question, "What is this?" It is idle to theorise about flowers and insects unless one is prepared to make observations in regard to particular flowers and particular insects—which raises the problem of species-identification. It is absurd to suppose that a precise terminology, which no one complains of on board a yacht, will not be even more necessary in the complex system of nature. It simply will not do to see the bird merely as "a drift of the air brought into form by plumes"; one must see it—see it really—as Kipling sees the locomotive or the steamship, and grasp something of its essence by a full knowledge of its anatomical inwardness. Cuvier discouraged, but eventually saved a student, who thought he had made a new discovery, by asking him if he had ever dissected an insect, and by bidding him do so.

In short, all experience goes to show that there can be no sound natural history without the anatomical, morphological, precisely analytic discipline which gives a partial answer to the question—"What is this?" The greatest of naturalists was a classifier and anatomist of the barnacles. On the other hand, I wish to suggest that we need the note of natural history to give interest and sanity to our morphology. What is the justification of the enormous amount of energy expended every year in adding to the mass of results reached by morphological analysis, and in mastering some small fraction of it for oneself? No one can pretend to have even a literary acquaintance with the whole vast volume of morphological facts. That is more impossible than it is for a man to know, or even to have seen, the whole of London. What we wish rather is to be able to read the volume, to find our way about, as it were, and to be able to add to the volume too when occasion demands. It is difficult to see any justification for merely adding to the volume aimlessly; there seems rather every reason to abstain from so doing. What we want is certainly not an encyclopaedic morphological knowledge. That is impossible without too great a sacrifice. We seek rather a general understanding of the chief styles and laws of

organic architecture, a general view of the certainties and possibilities of blood-relationship among animals, a realisation of what the word "organisation" means, and one criterion which will keep both teaching and learning sane and interesting is the old criterion of natural history. We must ask, Does this anatomical detail help us to a deeper and clearer insight into the real life as it is lived in nature?

There are other criteria, which I do not propose now to discuss, such as the rather dangerous criterion of practical utility, and what may be called the biological criterion which asks whether this or that piece of research or knowledge will help towards an understanding of the big generalisations of the subject.

The Second Question—How does this Act?

But close upon the first question—What is this? there rises a second—How does this act? It is equally natural and necessary, and throughout the progressive periods in the history of biology the two questions have never been far apart. They have evolved together, especially during this wonderful century, prompting one another to a more and more penetrating inquisitiveness. The key-word of the one is structure or organisation, of the other function or activity. The creature which our first question killed and picked to pieces has to be put together again and made to work. What does it do? how does it do it? how does it go? how does it keep agoing? how does it set other creatures like itself agoing? how long can it go? how does it cease from going? In other words, how does the organism feel and move? how does it grow and multiply? how does it waste, recover itself, and finally, in most cases, die? Above all, what is the secret of its activity and of its power of effective response to the order of nature? These are some of the physiological questions which recall Clerk Maxwell's boyish question—What is the go of this—the particular go of this?

We brush aside the old answers which speak of vital spirits and vital force, of conflicting temperaments and principles of life, not forgetting that we must sometime rehabilitate the truth which is in these verbalisms; we analyse the workings of the different organs which co-operate in the life of the whole, such as the beating heart and the digesting stomach; we pass beneath this to study the tissues that build up the organs—the contracting muscles, the controlling nerves, the secreting glands; we inquire yet more deeply into the waxing and waning of the cells and the complex chemical changes which occur in these; and we find that our second question is as unending as the first.

Here and there we make clear a chain of events, a procession of causes; we discover the hidden uses of various parts; we begin to understand certain corners of the internal economy; but to counteract any feeling of self-satisfaction we have simply to watch

any animal living its life in nature, responding effectively to its environment, and to ask ourselves again—How does this act? We must then confess that the way of the eagle of the air is still too wonderful for us.

The term physiology is now for the most part restricted to a study of the individual organism, and especially to a study of its internal economy. Just as anatomical analysis may be compared to picking a watch to pieces—an operation which dimly suggests the delights of dissection—so physiological analysis may be compared to a study of the kinetic aspect of the watch, and even when physiology becomes comparative it is still like comparing one kind of watch with another. To save the results from inexcusable partiality and incompleteness it is necessary to sound the natural history note, the recognition of organisms in the plural, as members of a pair, a family, a flock, an association, a fauna, as threads in a web of life, as agents in a complex environment. In our everyday work in the laboratory we have the bad habit of speaking of the earthworm, the crayfish, the skate, but to the naturalist these words are all in the plural.

It is recorded that young hermit-crabs which had been reared from eggs in an aquarium, and had never seen a shell, at once seized some shells which were dropped into the water, and had begun to explore them before they had reached the bottom. It is idle to say that this effective response is not as essentially part of the nature of the hermit-crab as its gills or gizzard. For the physiologist to ignore the answer which the hermit-crabs made to the stimulus of the shells would be as illegitimate as to ignore their respiration and nutrition. In short, no one can seriously maintain that physiological analysis has only to do with cells, tissues, and organs; it has equally to do with the intact living creature in its natural surroundings, with its domestic and social relations, with its habits and adaptations, with its struggle for existence and endeavour after wellbeing. Physiological analysis thus completes and corrects itself in "Natural History."

It is evident that physiological study supplements the anatomical answer to the question—"What?" The latter, if we are patient, will make a living creature practically translucent, will enable us, without any Röntgen rays, and, with our eyes shut, to see the animal through and through, each organ in its place. But the physiological discipline, if we are patient, will give us more—will give us a working thought-model, an intellectual cinematograph. I do not mean to suggest that there are not other results of anatomical and physiological study besides an increase in our power of visualising; but that is one result, and a very important one, for clear seeing is often the first step to clearer understanding.

We have heard wise warnings against the extremely analytic method of modern biology, against the necrology which is always destroying in the effort to understand. I have already recognised the danger in-

volved in the fact that our methods force us to abstract certain aspects of the organism. There is an undoubted risk lest we forget the unity of the organism which we take so carefully to bits; there is an undoubted risk lest we forget that what we measure and weigh and analyse belonged to a creature which had something analogous to our personality. We cannot dispense with our analysis, however, and the corrective for its partiality which I am at present pleading for is simply more study of the real life of the creature in its natural environment, in other words, more "Natural History." It will then be found that in proportion as our analysis has been thorough, our realisation of the life around us will be vivid. To say that no one really knows a bird who has not watched it build its nest may be true; but it may be justly retorted that no one really knows a bird who does not know something about the physiology of its respiratory system.

The Third Question—Whence is This?

A third question is—"Whence is this?" and though it is probably as ancient as the others, the answering of it is distinctly modern. It is really a double question, for we may inquire into the development—the becoming—of the individual, and we may inquire into the history of the race to which the individual belongs. We may study the child-animal in its cradle—the bee-grub in the comb, the embryo skate in its mermaid's purse, the chick within the shell—and the answer to the question—Whence came this individual animal as a whole and in each of its parts? is embryology. On the other hand, we may study the history of the race as it is hidden in the graveyards of the past, the fossil-bearing rocks, and the answer to the question—Whence came this race? is palaeontology.

To suggest how a minute embryological detail may become full of interest to the field-naturalist, I may refer to the familiar jelly which surrounds the eggs of the frog as these lie in the pond or ditch. The jelly is an albuminoid secretion formed by the walls of the oviduct round each ovum, and obviously comparable to the white in a bird's egg, though it does not seem to have the nutritive importance of the latter. So far a bald and not very interesting statement, but let us leave the spawn in the pond and consider the uses of the jelly there. It increases the buoyancy of the floating eggs; it renders fertilisation more secure by keeping the eggs together as they are laid; each sphere serves as an elastic cushion which lessens the risk of breakage to egg and embryo; the material is so slippery that few birds, except those with broad bills, can manage to swallow it; the stuff is unpalatable, so that even the voracious Gammarids leave it alone; and it has also been suggested that each crystalline sphere may serve as a sort of glass-house or incubator, enabling the developing egg to make the best of the sun's rays. On count after count even a dead

detail of structure, such as the jelly of a frog's egg, is justified by its utility.

Walt Whitman has it that "the tree-toad is a *chef-d'œuvre* for the highest," but perhaps it is not necessary to go beyond the spawn to learn the lesson taught to the apostolic fisherman that there is nothing common or unclean. Unless we soon learn that, there must be something seriously wrong with our learning or with our teaching.

Much of embryology is simply the anatomy of early stages, a little of it is an attempt to understand the physiology of growth and differentiation, and both these inquiries are obviously necessary to an understanding of the organism, but it is not difficult to show that embryology will be robbed of no small part of its interest and meaning if the natural history note—the bionomical note—is not sounded. The organism does not develop *in vacuo*, but in an actual environment, often a very definite one, which supplies stimuli of undeniable importance in liberating the developmental potencies, and imposes conditions to which many of the details of development are evidently adaptations.

Similarly, a true appreciation of palaeontology must also recognise the natural history note. For, although from one aspect palaeontology only differs from anatomy in that the subjects of examination died millions of years ago and are very badly preserved, from another aspect palaeontology is the study of racial history. To speak of the palaeontologist as a Dryasdust who pores over antediluvian vestiges, as an anatomist under difficulties, as a fossil-hunter, as a burrower in graveyards, is a caricature. The palaeontologist is the historian of the times before history, the specialist on the rise and fall of races, the student of "Werden and Vergehen," the biological scholar who endeavours to interpret the present in the light of the past. Now, just as it would be an imperfect archaeology which simply described remains without reviving in imagination the ancient life, so it is an imperfect palaeontology which does not, as cautiously as you will, at least try to reconstruct not the skeleton only but the living creature and the drama of life in which it played its part.

On the other hand, we may again to advantage sound the natural history note in recognising that what, after all, we especially require of palaeontology is to give us a better understanding of the life of the present. One step was taken by Cuvier, who insisted on ranking the fossils along with the modern types in a unified zoological system. Another step was taken, hesitatingly, by Louis Agassiz, who, though no evolutionist, recognised that "the history of the individual is but the epitomised history of the race"; and a further step, which may be called evolutionist, was taken when it was recognised that the present is the child of the past, though we do not yet understand how it was brought forth. These three steps have led us to feel that if we are to understand the life of the present in its distribution, its relation-

ships, its complex inter-adaptations, and its strange turns and twists of individual development, we must look for light in the inconceivably distant past. Just as we may see to read by the fireside of to-day by a light which is obviously the transformed sunshine of the carboniferous era, so the animal life of the past illumines that of the present, and it is on this account chiefly that we study it. To take a concrete instance, the migration of birds is a fascinating and extremely puzzling problem in natural history, the solution of which is still far off; but it will be admitted by most that the facts have become in certain aspects more intelligible by being considered in connection with the evolution of climates and with the great Ice Age in particular.

The Fourth Question.

There remains a fourth question, also ancient, but now asked with a new hopefulness—"How have these living creatures come to be as they are?" They have had a history—a slow racial evolution—as surely as they have an individual development; what have been the factors in this history? How has the raw material of progress, which we call variation, been made available throughout the countless ages? and how has this raw material been fashioned to shape and use? We have got a firm grasp of a modal interpretation—that the present is the child of the past—but we must beware of confusing this with a causal theory. The idea of evolution is the most potent thought-economising formula which the world has yet known, but as to the factors in the evolution we are still only inquiring.

I have said that there cannot now be a stable and progressive natural history which does not ask the three questions—What is this? How does it act? Whence has it come?—which does not, in other words, recognise the methods and results of morphology, physiology, embryology, and palaeontology; but I do not say that all useful natural history work must have this completeness of inquisitiveness or outlook. History would contradict this, though I doubt whether any of the immortals on the roll-call of naturalists did not in his fashion ask all the questions. It is plain, however, that Reaumur was little concerned about the palaeontology of insects, and that Gilbert White knew nothing of the embryology of the earthworm. It is plain that Christian Konrad Sprengel was not much interested in histology, and that Buffon knew little of the physiology of the individual. Yet all the four were such splendid naturalists that it seems almost an impertinence to praise them. Just as I presume no one would deny the artistic mood to the author of a picture which was exquisite in form but weak in colour, or of another which was feeble in its form but a joy for ever in its colour, so we reverence the old naturalists none the less in admitting their limitations.

This saving paragraph is necessitated by the fact—the historical

fact—that there have been many consummate naturalists who never asked the fourth question at all, who took nature as they found it, saw it, saw its activity, saw its "whence," but never inquired as to its "how"! To omit this question now would be to label oneself a Rip Van Winkle; not to have asked it in pre-Darwinian days, or to have refused its legitimacy as a scientific question was quite congruent with the intellectual environment of the time. But Darwin gave naturalists a new organon, not to use which means "an unlit lamp and an ungirt loin."

On the other hand, it is equally evident that in our attempt to answer the question "How has this come to be as it is?" we must keep in touch with the actual facts of the case. We may take advantage of intricate mathematical methods in our study of variation, but we must be continually returning to the actual cabbages in the garden and the real herrings in the sea. We may take advantage of logical controversies about natural selection to sharpen our intellectual weapons, but we must be continually returning to an actual observation and measurement of the struggle for existence among the crabs on the shore or among the seedlings in the plot. We may use abstract hypotheses, such as Weismann's theory of the germ-plasm—which even its fiercest critics must admit to be one of the most logically ingenious and complete hypotheses in the history of science, and to have provoked research more than any other biological idea except that of natural selection—but as Weismann says—"the test of the usefulness of theories lies in the applying them to special phenomena; it then becomes apparent whether and where they touch improbabilities, and where new facts are required to improve them or to replace them by others." We may think out our hypotheses by the fireside, but this will be of little avail unless we condescend to test them in open air.

Even in regard to experiment, while there is no lack at present of ingenuity in playing tricks with cells and eggs, embryos and larvae, and while no one can predict the outcome of what Darwin called fools' experiments, it is plain that those are likely to be of most value which are definitely related to the possibilities of actual occurrence in nature.

It must be clearly understood that the evolutionist has not at present any rounded-off and demonstrated generalisations like the law of the conservation of energy or the law of gravitation. He has a certain way of looking at things, he believes that they have had a natural history, he has a formula, a modal interpretation, the general idea of evolution. He has also particular causal theories, all of them very young, which he seeks to test, but which from the nature of the case he has little hope of demonstrating in the strict sense. With his general idea and his particular causal theories, his continual occupation is to see whether his keys fit the locks of actual fact—an occupation of perennial interest. Sometimes he has fancied himself

the possessor of a master-key, but some new lock has baffled him, and it seems likely that this will be his experience for many years to come. In one of his essays, Professor Weismann rejects the common opinion which compares science to a building resting on sure foundations and rising from a firm basement safely to the highest story; on the contrary, he says of the exact sciences—"They all build from above, and not one of them has found a basement yet—not even physics."

An Illustration.

Let us now consider a single fact of natural history so that we may see more clearly how an understanding of it makes demands on all the resources of our discipline. It is well known that the mole stores earthworms for use in winter—as many as a hundred being sometimes found together; it is a less familiar fact that these stored earthworms are, in many cases at least, decapitated, so that although alive they are unable to crawl away. We may begin by asking how the mole and the earthworm happen to be both underground, which is certainly not the primitive home of their respective races; we pass on to inquire how the mole catches the earthworms, and how they are often able to avoid the mole; another query raises the problem of the storing instinct; a side question leads us to consider the mole's imperfect lenses and the peculiarity of its optic nerves; then we are bound to inquire how it is that the decapitation of the earthworm prevents its crawling away; and this brings us to consider the function of the head-ganglia as a motor centre. We know that in summer a lost head-end may be re-grown, but that this does not occur in the low temperature of winter, a fact that raises the whole difficult problem of regeneration; we know that the re-grown anterior part sometimes turns out to be a second tail instead of a new head, which forces us to face the fact that there are limits to the perfectness of adaptations. We cannot avoid inquiring, too, how far the mole's destruction of earthworms, which are for the most part valuable agriculturally, is compensated for by its destruction of injurious insects. And so from the unearthed store of earthworms in the mole's burrow we pass to problems of nerve physiology, comparative psychology, conditions of development, rural economy, and what not—inquiries which surely become more real and interesting to investigator and student alike when they are centred round an everyday fact of natural history.

The Essence of Natural History.

When in our anatomical or zootomical studies we propose to dissect the skate or the snail, or the like, we must first isolate it from its environment and kill it; in other words, we have to make an abstraction—a very necessary and valuable one, but still an abstraction.

And just as no one dreams that the study of man begins or ends in the dissecting-room, so we must supplement our comparative anatomy, physiology, and embryology of animals by getting back to the natural history picture. If we do this carefully we shall probably discover that our study of organisms is even wider and grander than we had supposed. We see the living creatures as parts of a great system of things, amid which they live as unities, especially marked off from things which do not live by their characteristic power of effective response, and bound to other components of the system by complex inter-relations, to appreciate which fully is indeed beyond the reach of any one man, since it means a grasp of natural history in the oldest, widest sense of the term—the science of the order of nature. Thus, the two notes suggested by the old term "natural history" are really one—the actual life of organisms implies such complex and far-reaching inter-relations that we need all science to enable us to appreciate it.

We speak of the correlation of organs—meaning that the various members are closely bound together in one body—but we do not speak enough of the correlation of organisms. Whether we take Gilbert White as representing the old school, or Darwin as representing the new, we get the same impression of nature as a vibrating system most surely and subtly interconnected. And to have the vision of the web of life is one of the ends of our study. We are familiar with striking instances—the links between cats and clover crop, between earthworms and the world's bread supply, between white ants and tropical agriculture, between ivory ornaments and the slave trade, between bicycles and the persecution of the walrus, between stable manure and the carp in the fish-pond—all "house-that-Jack-built" conundrums until the procession of causes is worked out. But what we have to realise is that these curiosities are simply quaint examples of what the naturalist sees or has to find throughout the world. One may say, with all reverence, that much of Darwin's work has been an eloquent commentary on that memorable saying regarding the sparrow that falls to the ground. Such a simple event literally sends a throb through nature; we can follow its effects a few steps, just as we can follow for a few yards the ripples made when we throw a stone into a still sea; in neither case can we doubt that the spreading influences are real though they pass beyond our ken.

In Conclusion.

Perhaps, in conclusion, I may suggest another advantage in continually returning to the facts of the case, to living creatures as they live in nature. This other advantage is that it saves us from the common error that the naturalist has arrived at any ultimate explanations of things, or that as naturalist he even seeks for them. The word "ultimate" does not occur in the scientific dictionary. Science

describes, analyses, discloses chains of sequence, gives mediate explanations, perhaps, but certainly no ultimate explanations. We get hold of certain fractions of reality which interest us, we seek to see them as clearly as may be, to put them in an ordered series, to reduce them, if possible, to a common denominator, but we do not explain our common denominator, any more than the philosopher his greatest common measure. We may seek to explain certain facts in terms of protoplasm, but we do not explain protoplasm; we continually speak of the organism, but no one knows what the secret of its unity is; we believe that animals have been "evolved," but we know that to say so is to raise a problem rather than to solve it. From the careful study of any biological question we are bound to end in this recognition of the relativity of our aims, to feel, as Fouillée says, that science is like a broken mirror, whose reflections of reality philosophy seeks to reunite, but if at any time we should be tempted to ignore it in our satisfaction at the illumination of some dark corner, or at the successful testing of some hypothesis, we shall at once regain sanity if we go out into the midst of the real life of sea and river, of wood and meadow, and looking Nature full in the face dare to say—"We can explain all this."

I have spoken of the naturalist's work only in so far as it helps us to a greater appreciation and understanding of the life of animals in nature. I have said nothing of its relations to the practical life of man which animal life touches at so many points. I have said very little of its relations to the big problems of biology—protoplasm and the cell, growth and reproduction, heredity, and the like. To have discussed these would have obscured my simple thesis, which is just this, that a stable and progressive natural history requires all the help which the special disciplines—the answers to our four questions—can afford; and, on the other hand, that the special disciplines lose in interest, dignity, logical completeness, and effectiveness if they lose touch with natural history.

A well-known philosopher is reported to have spoken of natural history as "one of those Kindergarten subjects," but perhaps there is no reason for us to take offence at that. We do not go far before we find that the study of natural history raises problems even to state which requires all the intellectual virtue and manliness which we may have; and yet the suggestion of the Kindergarten prompts me to say that we shall not do ill if we can study our subject with the inquisitiveness, open-mindedness, daring, and humility of children. For it is true of the kingdom of science, as of the Kingdom of Heaven, that it is as little children—cautiously trying our steps—that we may enter in.

Fresh-Water Biological Stations: America's Example.

By D. J. Scourfield.

About two years ago Prof. Anton Fritsch, the veteran Bohemian naturalist, called the attention of biologists in this country (*Nat. Sci.* March 1897, p. 169) to some of the work being done on the Continent in connection with the establishment of fresh-water biological stations. It is now proposed to supplement Prof. Fritsch's article, and thereby of course to enforce its moral that England is altogether behind the times in the matter of fresh-water biological stations, by giving a few details of the progress made in America in this respect.

It was in 1893 that the first serious attempt was made in the United States to undertake detailed fresh-water biological work on modern lines. In the summer of that year a small party of enthusiastic naturalists, under the able leadership of Prof. J. E. Reighard, and supported by the Michigan Fish Commission, established a temporary biological station on Lake St. Clair. The work of the party was directed towards the elucidation of the biology of the lake in all its phases, with the practical end in view of discovering the actual facts concerning the environment of the white fish, the yield of which in the great lakes had been steadily diminishing, in spite of a large outlay for artificial propagation. The outcome of the two months' work, although not leading at once to any very definite practical result, was very valuable from a scientific point of view, as may be seen by a reference to the papers on the plankton and the different groups of the fauna and flora of the lake published in the *Bulletin of the Michigan Fish Commission* (see Nos. 8, 13, 16, and 17 of list appended).

The next year (1894) saw a very considerable increase in the amount of attention paid to fresh-water biology in America. The enlightened Michigan Fish Commission again enabled a temporary biological station to be maintained; on this occasion at Charlevoix, for the investigation of Lake Michigan. Excellent work was accomplished here by Prof. H. B. Ward and his companions, and a summary

of the principal results obtained was published in No. 6 of the *Bulletin* already referred to (23).[1]

During the same year, Prof. C. D. Marsh commenced (following up some preliminary work of the previous year), his systematic investigations on the limnetic crustacea of Green Lake in Wisconsin (14). Prof. E. A. Birge also started his elaborate "Plankton Studies" on Lake Mendota in the same State (1). Although in these cases the observations were not carried out by means of a formal biological station, the work done has been essentially such as would occupy such a station, and in fact the position of the University of Wisconsin on the shore of Lake Mendota enabled Prof. Birge to have all the advantages of a biological station without the trouble of specially organising one for his research. The important results of Prof. Birge's work have been already alluded to in this Journal. (See *Nat. Sci.* vol. xii. pp. 295-6.)

But the most notable event of the year 1894 was the establishment, by the Illinois State Laboratory of Natural History, in conjunction with the University of Illinois, of a biological station at Havana on the Illinois River, under the direction of Prof. S. A. Forbes. This station took the form of a large floating laboratory, affording working accommodation for about twenty persons. It was specially built for the purpose it has to fulfil at a cost of $1,255, and it has been equipped with all kinds of collecting and other appliances used in biological investigations. As regards literature, the station is able to draw upon the library of the State Laboratory of Natural History, which is exceedingly well supplied with works on fresh-water animals and plants. Besides the floating laboratory, a small steam-launch also forms part of the station equipment, together with a number of row-boats (4 and 11).

The district worked by the Illinois station, viz. the Illinois River near Havana, and the lakes, ponds, and swamps immediately connected therewith, appears to be an extremely interesting one from the biological point of view, and a considerable amount of valuable investigation has already been carried out by the station staff and visiting naturalists. The general object has been to study the forms of life, both animal and vegetable, in all their stages, of a great river system. It would be absolutely impossible, in an article of this kind, to allude in detail to all the results which have followed from the establishment of the station. Some have been noted from time to time in *Natural Science*, but a few indications may also be given here of the kind of work that has been done.

From the very first, quantitative collections of the plankton organisms have been made at regular intervals from certain selected

[1] A biological survey of Lake Erie, supplementing the work done on Michigan and St. Clair, was undertaken last year under the auspices of the U.S. Commission of Fish and Fisheries, but no results have yet been published.

localities representing different types of environment. These were at first made by a modification of the Hensen-Apstein methods, but as the work proceeded several important alterations were introduced, such as the employment of a pump for the collection of the plankton material, and of a centrifuge for its rapid deposition. Numerous painstaking experiments have also been made with a view to determine and correct the errors in quantitative plankton methods in general, and all workers in this field are indebted to Dr. C. A. Kofoid, who has had charge of this department, for the light which he has thrown on the subject (9 and 10). Unfortunately, owing to the large amount of labour involved in working out the collections, and the small staff available for the purpose, none of the results of the actual work on the plankton have yet been published. When they do appear, however, they can hardly fail to be of the highest scientific value.

The aquatic insects have received a large share of attention at the Illinois Biological Station, and it has been the special endeavour of those working at these forms to get full particulars of the life-histories of the species, both by constant collecting and by breeding. In this way a large amount of information has been collected on the immature stages of over two hundred different species, the great majority of which had not been previously known (5).

Besides the insects many other groups of animals have been carefully and profitably studied, as is abundantly clear from actual publications dealing with the Protozoa and Rotifera (6 and 7), Oligochaeta (21 and 22), Ostracoda (20), and Copepoda (3, 18 and 19). Materials have also been accumulated for treatises on several other important groups.

In addition to the special researches carried on by the station staff and visitors, an attempt was made last year to run a summer school of biology in connection with the station, with regular courses in botany and zoology. Although hardly so well attended as was anticipated, the scheme was thoroughly successful (4, 1897-8). Such a school should be of the greatest practical importance in the training of biological students, and it is to be hoped that when the exceptional advantages offered by the Illinois Biological Station are better known there will be no need to complain on the score of attendance.

The year after the establishment of the Illinois station, *i.e.*, in 1895, Professor C. H. Eigenmann was enabled, with the aid of the Indiana University, to open a biological station on the shores of Turkey Lake in Indiana. The main scientific object of this station has been the study of variation, and to this end a small lake, within which the influences of environment are presumably reduced to a minimum, was purposely selected. During the four years since the starting of the station a large amount of material has been obtained to illustrate such points as the annual variation, the birth mean, and the effect of selective destruction, but only a portion of this has yet been thoroughly

examined. Among other published results, however, has been the issue of a valuable paper by W. J. Mönkhaus on the comparative variation of two species of darter fishes living in Turkey and Tippecanoe lakes (15), from which it appears that the specimens of both species in one lake differ in every structure examined from those in the other; further, that they are modified in the same way in the the same lake, and that this is not the result of selective influence but apparently the direct effect of the environment. Apart from the scientific work accomplished by its aid, the biological station has also been of immense service to the Indiana University in connection with the training of biological students, of whom no less than 105 made use of the station last summer.

A year later (1896) yet another fresh-water biological station came into existence in the United States. This was the Lake Laboratory of the Ohio State University, established at Sandusky on Lake Erie, under the direction of Professor D. S. Kellicott. This station was started mainly to afford favourable opportunities for the students and instructors of the university to study the fauna and flora of one of the Great Lakes and of the rich zoological district around Sandusky. The subjects to which special attention has been given during the time that the station has been open, have been the fishes, their food and parasites, the aquatic insects, the rotifers, the sponges, and the crayfishes. Some progress is also said to have been made in the investigation of the plankton. As nothing seems to have been published, however, bearing directly on the results obtained by the workers at the station, it is not possible to give any details on this subject. It is sincerely to be hoped, nevertheless, that, notwithstanding the death of Professor Kellicott, the work of the station will be continued and its results given to science in due course.

In addition to the foregoing stations actually in existence, proposals have been made to establish similar institutions in Iowa, at Rochester in western New York, and elsewhere. Canada, too, is hankering after a fresh-water biological station, although in spite of the grant of £75 by the British Association when in Toronto, nothing definite appears to have been done in the matter. Altogether there appears to be little doubt that the year 1900 will see at least half a dozen fresh-water biological stations at work in America.

The contrast between such a state of affairs and that existing in this country is surely enough to make us ask anew,—When will our biologists wake up to the fact that good systematic work can be done and important biological problems attacked by fresh-water as well as marine stations? When shall we be able to report to our Continental and American confrères that, in the words of Dr. Fritsch, England has done her duty by fresh-water biology? Unfortunately it is only too true that up to the present **England has not done her duty** in this matter, and as a striking instance of this it may be pointed out that of

the very considerable knowledge which we now possess about the organisms constituting the plankton of fresh-water lakes—*e.g.* their remarkable and often complicated variations in abundance during the year, both collectively and taken species by species, their vertical distribution in regard to the season, to the time of day, to the so-called "Sprungschicht," their occasional seasonal variation of form, their relation to one another and to the other lake forms, notably the fishes, —of all this and much more not one single fact has been contributed by this country! Who said "Shame"?

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Weismann's "Regeneration."

By Professor Marcus Hartog, D.Sc.

Forewords.

The following abstract of certain principles of controversy implied in Prof. August Weismann's paper on "Regeneration" in the April number of *Natural Science*, is not intended to be of the nature of "invectives, sarcasm, or derision" (p. 323); for these weapons, the matter is far too serious. The human love for a complete system is so great that any clearly expounded system that covers a very large number of well-known facts is sure to be widely adopted, so long as those other facts that are incompatible with that system are unknown or ignored. Weismann's own contributions to our knowledge of facts are so numerous, careful, exact, and important, his earlier theoretical work is so valuable in every way, that his name added weight to his "Systema Generationis" even in its earlier, recalled editions. His candour in admitting errors therein, when they had been demonstrated to the world, his unremitting patience and ingenuity in rebuilding his edifice after such a ruin as befel its foundations in his papers on the meaning of sexual reproduction, are deserving of our warmest admiration and sympathy. We owe him a great and enduring debt for clearing our ideas, for making us give reasons for our faith, for banishing many an old error from science. In his last paper, however, of which he says, "I have written it rather for the supporters than for the opponents of my views," he has pursued a course fraught with dangers, masked by the greatness of the authority of his name, and only to be averted by being brought clearly into light. The canons of argument and ethic which present these dangers are therefore summarised, with quotations from his text in which they are exemplified; and this also is done for the benefit of those for whom the paper is written—"the supporters rather than the opponents" of the germ plasm hypothesis. For their benefit again it is desirable to point out that "Auslösung" is used by Hertwig in its current technical physiological sense as equivalent to "discharge"—of gunpowder, not of a cargo-boat; the connoted "setting free" is a setting free of energy, not of matter; and, consequently, its translation by "liberation" in this paper is incorrect,

and carries with it a fallacious and question-begging connotation of the "liberation" of Weismannic determinants.[1]

The debt all thinkers in biology owe to Weismann makes the writing of this abstract an ungrateful, if necessary, task. To go further and to criticise is fortunately unnecessary.

Canons.

Canon I.—If ONE *of many possible hypothetical explanations of a process is refuted, Weismann's explanation of that process is* PROVED.

Example.—"In the face of such facts the hypothesis of a general power of regeneration, which restores the life crystal to its integrity, is obviously untenable. Here the crystal is restored after an older pattern, and one cannot see why this should be so, since the whole has been no more altered than a dodecahedral crystal would be if the point were broken off. If in that case the missing portion were suddenly to be recrystallised on another 'system,' it could only be because the elements from which the restoration started were not the remaining whole but particular parts belonging to another system, or —to translate into the language of biology [*this is a synonym for expression in terms* of the germ plasm hypothesis]—because at the injured place there were regeneration 'Anlagen' of earlier origin, which came into play as the result of the injury. The existence of 'Anlagen' is thereby proved" [Q.E.D.], p. 313.

Canon II.—A statement that facts are only possible on Weismann's hypothesis is proved by repeating the statement with one or more of its terms replaced by synonyms or synonymous phrases.

Example.—"Determinants [defined seven lines below as 'working living particles which operate during the course of development in a definite manner, so that the part they have to determine is thereby produced'] must be present because the parts of the organism are capable of individual and transmissible variation, and this is only possible if there are in the germ plasm living particles related to definite parts of the perfect organism" [i.e. *determinants*], p. 321.

Canon III.—A fact contrary to Weismann's doctrine may be (a) *dropped, or* (b) *reversed.*

Example (a).—"But further investigations by Blochmann and myself led to the discovery that parthenogenetic eggs only form one polar body, while those which require fertilisation always form two" (p. 324); [*the* FACT DROPPED *is that the bee's egg always forms two polar bodies, and yet will develope—into a drone—without "requiring fertilisation"*].

Example (b).—"Thus the conclusion has been gradually more and more firmly established that in the sex-cells of animals as well as in

[1] For the translation or mis-translation, however, Prof. Weismann, who was good enough to send us his German MS., is in no way responsible.—[ED. *Nat. Sci.*]

those of plants a reduction of the number of chromosomes takes place" (p. 325). [*The* FACT REVERSED *is that the reduction, be its mode and interpretation what they may, takes place in the* ASEXUAL *spore formation in Archegoniate plants, not in the formation of the* SEX-CELLS.]

Canon IV.—The names of observers may be cited in support of a Weismannic interpretation of the facts, without mentioning that the observers themselves maintain that the facts are irreconcilable with these interpretations.

Example.—"I need only mention the names of Boveri, Henking, Vom Rath, Rückert, Häcker, Korschelt, Ischikawa, and Van der Stricht; and in the domain of botany, Strasburger, Ischikawa, Calkins, Beliejeff, and Guignard." *This follows a statement* on the reduction processes in the nucleus: "I therefore altered my second hypothesis to a third, according to which both divisions of the ripening ovum together imply a reduction in the number of ids, and this position I still maintain" (p. 324). [*Yet the observations of Boveri, Guignard, and Strasburger are regarded by them as inconsistent with "this position."*]

Canon V.—It is immaterial to acknowledge Weismann's debt to those who have pointed out the untenability of his former theories, and induced him to recast them on a sounder logical basis.

Example.—"It is immaterial whether I myself or one of my sharp-sighted critics was the first to discover this mistake" (p. 326). [In what sense is it immaterial for the constructor of a theory to acknowledge his debt to those who point out that its foundations are unsound?]

QUEEN'S COLLEGE, CORK,
May 11, 1899.

The Anal Glands of the Aphodiinae.

By Dr. L. Bordas.

The anal glands of the Aphodiinae differ essentially in their form and situation, and above all in their structure, from those of the other Coleoptera. While these organs generally consist either of a series of small spheres disposed in clusters, or of two long appendicular tubes (Dytiscidae, Gyrinidae), those of the Aphodiinae (*Aphodius fossor* ♂ L.), on the contrary, consist of a series of unicellular secretory acini—spherules provided with a very delicate canaliculus ending in an efferent cylindrical duct. This disposition reminds one of the form which obtains in the glands we have described in the Hymenoptera (Apinae and Bombinae), under the name of supracerebral glands (see *Ann. Sci. Nat.* [*Zool.*], 1894; "Appareil Glandulaire des Hyménoptères," Plate 1, Figs. 10, 11, and 15).

The anal glands are paired and open separately at two points very near each other on the basilar plate immediately under the chitinous case that constitutes the principal piece of the genital armature.

Each gland is composed of a multitude of unicellular acini, disposed in groups along the principal excretory duct of each gland. Those acini are generally spherical, and contain an internal granular protoplasm with a few peripheral vacuoles.

The nucleus that lies near the centre of each cell encloses several nucleoli. A very thin membrane surrounds each acinus, and is continued into an excretory canaliculus which is short and very thin. This canaliculus takes origin by several branches at the centre of the acinus. All the canaliculi open directly into two uniformly cylindrical tubes, which may be designated the excretory canals of the gland. There is no collecting reservoir as in the other cases. There is, therefore, as this short summary indicates, a quite special structure in this particular case. For further details I must refer to my memoir on the defensive glands of insects.

Marseille.

FRESH FACTS.

VENTILATION OF EGGS. OSKAR SCHULTZE. "Ueber den Einfluss des Luftmangels auf die erste Entwicklung des Eies," *Verh. Phys. Med. Ges. Würzburg*, xxxii. 1899, pp. 191-202, 4 figs. When frogs' eggs are robbed of their normal supply of oxygen for a short time, the development is slowed. In more unpropitious conditions the development stops, but it may recover even after a stoppage of two days if good ventilation is restored. In most cases, however, the inhibition results in malformations, and eventually in death. The result may be due to poisoning with carbonic acid as well as to actual dearth of oxygen, for an organism will form CO_2 even in the absence of supplies of oxygen. It is safe to say that good ventilation is an essential condition of normal development from the time of fertilisation onwards.

APLYSIOPURPURIN. C. A. MACMUNN. "The Pigments of *Aplysia punctata*," *Journ. Physiol.* xxiv. 1899, pp. 1-10, 2 pls. Aplysiopurpurin is an extremely unstable pigment secreted by the dermal glands of *Aplysia*, and varying slightly in different species. It can be isolated in a pure, or at least an approximately pure condition, by means of precipitation with ammonium sulphate and further treatment described in the paper. The integument of *Aplysia* contains pigments which appear to be of an excretory nature, besides a special violet pigment.

GENITAL ORGANS OF HOLOTHURIANS. L. BORDAS. "Recherches sur les organes de la génération de quelques Holothuries," *Annales Faculté des Sciences Marseille*, ix. 1899, pp. 187-204, 1 pl. In this research, which the author has sent us from the laboratory of Endoume, the structure of the reproductive organs in *Holothuria tubulosa*, *H. poli*, *H. impatiens*, and *Stichopus regalis*—all abundant in the Gulf of Marseilles—is described. Macroscopically, this is very simple, and almost the same in both sexes. Microscopically, the tubes consist of germinal epithelium on a basilar membrane, then a connective fibrillar layer, then a layer of circular muscle-fibres (outside which there may be longitudinal fibres), and externally a layer of cylindrical ciliated cells. Dr. Bordas commends the edibility of the organs as not inferior to those of sea-urchins, which many find appetising.

STRUGGLE FOR EXISTENCE. F. P. BEDFORD. "Gecko Cannibalism," *Nature*, lx. 1899, p. 8 (Letter). In a stomach of a young female gecko (*Gecko monarchus*) there was found a smaller gecko of the same species. As the writer says, "the fact that an animal will prey upon another of its own species, while living under completely natural conditions, and with an abundant supply of its normal insect food, seems worth recording."

ENTEROCHLOROPHYLL. C. A. MACMUNN. "On the gastric gland of Mollusca and Decapod Crustacea: its structure and functions," *Proc. Roy. Soc.* lxiv. 1899, pp. 436-439. Dr. MacMunn has been forced by his observations to believe that enterochlorophyll is a pigment which primarily has been taken up

from the intestine dissolved in a fatty medium, and is carried, either by leucocytes or in some other way, to be deposited with the fat and perhaps other reserve products in the gastric gland. Whether it is utilised for the production of other pigments or not is a question for future investigation. That it is a chlorophyll derivative he now believes to be proved. Its stability, as compared with plant chlorophyll, is due to the fact that it has been altered by the action of the digestive juices.

SHELLS IN OCTOPODS. A. APPELLÖF. "Ueber das Vorkommen innerer Schalen bei den achtarmigen Cephalopoden (Octopoda)," *Bergens Museum Aarbog.*, 1899, pp. 1-15, 2 pls. It is usually said that Octopoda differ from Decapoda in the absence of an internal shell. There is, however, such a structure in a cavity on the dorsal surface of the mantle in the aberrant Cirroteuthidae, and Appellöf interprets in the same way two narrow chitinous rods in Octopodidae. The cavities in which these rods lie are lined by an epithelium which secretes the concentrically laminated chitin.

A TOOTH IN A TESTICLE. A. E. METTAM. "Dentigerous Cysts," [*The Veterinarian*, lxxii. 1899, pp. 309-312. In this interesting note Prof. Mettam describes *inter alia* a case in which the testicle of a horse, removed during an ordinary castration, contained a fully developed canine tooth with a bony alveolus enclosing its fangs.

A RECORD HOMER. T. FOWLIE. "Vitality of Pigeons," *The Veterinarian*, lxxii. 1899, pp. 316-317. As surgeon for the Aburn Homing Club, N.S.W., the author has seen several instances of marvellous vitality and recovery from severe lacerated wounds in pigeons. One bird, "a record homer," had the muscles of the neck terribly lacerated, the trachea and oesophagus exposed from the pharynx to the clavicles, the ingluvies laid open and a third of its walls destroyed. The wounds were treated and recovery was complete. The bird has since reared one brood, and is going to race again. What astonishes the author most is that the healed ingluvies "can be of no practical use as an organ of digestion;" but who said it ever was?

GEOLOGY OF THE MALAYAN ARCHIPELAGO. B. KOTO. "On the geologic structure of the Malayan Archipelago," *Journ. College of Science Tokyo*, xi. 1899, pp. 83-120, 1 p. In this welcome contribution Prof. Koto gives a brief sketch of the geologic and tectonic structure of the island-world of South-Eastern Asia, usually comprehended under the name of the Malayan Archipelago. His primary motive was a desire to compare the physical features of the island of Taiwan with those of the Far Eastern Indies, and the inquiry has broadened out. As he says, the great Viennese geologist, Prof. E. Suess, has already drawn a lively picture of the structure of these islands in his "Antlitz der Erde," but this account has been enlarged and modified in the paper before us.

PTERYGOTUS AT MELBOURNE. F. MCCOY. "Note on a new Australian *Pterygotus*," *Geol. Mag.*, N.S., dec. iv. vi., May 1899, pp. 193-194, 1 fig. No merostomatous arthropod has previously been recorded from Australia. This specimen described as *Pterygotus australis* n.sp., is about half a somatic segment in black flaggy Silurian (s.str.) rock, from the main sewer tunnel in Domain Road, South Yarra. It was collected by F. Spry, who has presented it to the Melbourne Museum.

SOME NEW BOOKS.

The Native Tribes of Central Australia. By Professor BALDWIN SPENCER and F. T. GILLEN. Pp. xx. + 671, with 133 figures, 2 maps. London: Macmillan and Co., 1899. Price 21s.

If we may judge of the progress and vitality of a science by the nature of the literature called forth in response to the demand for information, we may assuredly regard the scientific study of man, hampered though it be by the cumbrous title of anthropology, as one of the most progressive of the sciences. Anthropologists have certainly responsibilities of a serious kind, and it is one of the most curious phenomena of research, that the scientific study of man himself, a study of such great and varied interest, and of such wide practical importance, should have to rank as almost the youngest of the sciences. Fortunately its youthful age is now associated with a youthful vigour which promises well for the future; but, at the same time, it must be admitted that every year, every month in fact, lost in delaying the active prosecution of scientific inquiry into the physical characteristics, customs, and arts of the lower races of mankind, and their relation to their environment, renders the task of the science more difficult, owing to the vanishing of the materials for study. The "civilisation" of the savage not only means the substitution of the customs and arts of the more cultured races for those of primitive peoples, but too often implies the extinction of the lower race itself as a race, it may be by a gradual process of absorption into a pseudo-civilised state, and the suppression of normal racial characteristics, it may be by actual extermination. We may well rejoice at the present signs of activity in the prosecution of anthropological research in Australia. The recent "Horn" expedition, carefully organised for scientific investigation, was brought to a successful issue, and produced excellent results, and the report on the anthropology of the districts visited contains valuable materials brought together by Messrs. Stirling and Gillen. For some while Brough Smyth's "Aborigines of Victoria" was the classical work upon Australian native life, but later this was followed by splendid work on the part of Messrs. Howitt and Fison, work of a most painstaking and sterling character. Quite recently Dr. Roth published his observations upon the natives of the north-eastern regions, an excellent and most useful monograph, bringing to light many new facts, and stimulating afresh the interest in Australian anthropology. Now we have in our hands the volume recently produced by Messrs. Spencer and Gillen. Of this work it is difficult to speak in terms of sufficient praise, a volume of upwards of 650 pages, positively packed with information of a valuable kind. One may fairly regard this book as one of the most important contributions to anthropological literature of recent years. Prof. Spencer has brought to bear upon the subject his training as a scientific biologist and skilled observer, and it is indeed fortunate that he has been able to devote so much of his time and energies to the study of man. Mr. Gillen has long been resident amongst the natives of Alice Springs, as a protector of aborigines, and has had,

and made use of, unrivalled opportunities for acquainting himself with their manners and customs, and the inner workings of the savage mind.

These two observers have collected an enormous mass of facts, a large proportion of which have come under their personal observation, and the result of their searching inquiry is that they have been able to carry us far behind the scenes of savage life, and to supply much long-needed information concerning the *arcana* of Australian savagedom.

The social organisation of the tribes is described in detail, starting with the fundamental division of the tribe into two exogamous intermarrying groups, which may be further divided, but whose former existence is always manifest. The elaborate systems of relationships between members of the tribe become more and more complicated as the divisions become more complex, and the native terms of relationship become very numerous. It is necessary to use the native terms in dealing with relationships, for many of them have no equivalent in English. The laws regulating marriage are very strict, and a very limited power of selection is allowed to the native in search of a mate. Totemism enters largely into the social system, and is one of the dominant factors in social regulations. The totemic system is one of great interest in this region, and the information collected thereon by the authors of this work is of very great importance in relation to the general subject of totemism. The laws regulating food restrictions in relation to the eating of the totem animal or plant are very significant, and point to a gradual development from a period of greater freedom in the matter. The statement that, in the Arunta tribe, the child belongs to the totem of the spot at which the mother believes that it was conceived, is one of great interest. It is clear that the totem is not inherited from either father or mother, and that the whole matter is bound up in the doctrine of reincarnation of ancestors, whose spirits have remained at certain spots in the sacred *churinga*. From the *churinga* the spirits of the Alcheringa ancestors and their descendants pass into women visiting the sacred spots, and hence the child belongs to the totem of the place itself, which is the totem of the bygone tribesmen whose spirits have continued to inhabit the *churinga* deposited there.

These *churinga*, equivalent to the so-called "bull-roarers," are described in a manner which shows how vastly important a part they play in all the mysterious ceremonial of the natives. They may never be seen by women. No such complete description of their use exists elsewhere, although Messrs. Howitt and Fison and others have shown their great importance, and the mystery surrounding their use.

The history of a tribe is referred back to the Alcheringa days, a time long past, in which the ancestors of the tribe are supposed to have existed as a mythical, semi-human race. The wanderings of the Alcheringa ancestors are carefully treasured up in the native memory. These traditions are of use as pointing to the probable migration routes of the various tribes and sections of tribes, and to the development of their culture and ceremonial observances.

The complicated, severe, and prolonged initiation ceremonies are recorded in the book with great care and precision, all the phases being described with a minuteness of detail which reflects great credit upon the observers.

It would be impossible, in this notice of the book, even to touch briefly upon the numerous points of interest raised in this work, and no attempt can be made to do so. The whole forms a very concise account, and is, moreover, liberally furnished with illustrations prepared from photographs. They are for the most part very good.

If a work of this kind still leaves us with the feeling that there is yet a vast amount to be learnt from the natives, as regards their customs and beliefs, and the esoteric side of their culture, this is no fault of the authors. We will hope that the example set by them may be followed by others, while there is yet time to study primitive native life in its natural environment.

HENRY BALFOUR.

PROGRESSIVE VULCANOLOGY.

Volcanoes. By Prof. BONNEY, D.Sc., F.R.S. 8vo, pp. xvi. + 351, with 12 plates, 21 figures, and a map. (The Progressive Science Series.) London: John Murray, 1898. Price 6s.

Volcanoes are of interest to so wide a circle of general readers, and, at the same time, they present so many problems which engage the attention of men of science, that one is often led to wonder that, numerous as are the books already published about volcanoes, there are not more of them still. Historian, poet, mythologist, artist, geographer, and geologist, all find in this one subject matter of perennial interest, each according to his own special line of thought. Little wonder, therefore, that the authors of the various books that have been written about volcanic phenomena have treated their subject in styles so diverse. Little wonder, also, that when a new book on the subject appears, the majority of its readers, while grateful to the author for presenting them with well-known facts in a new light, and for telling them much about other matters that they had not known of before, yet feel that they are not quite satisfied. Whether it is possible for any man to write a book on volcanoes which shall give universal satisfaction is another matter—perhaps it would be safe to say that it could not be done, because no two thinkers ever regard the subject in exactly the same light.

Whoever undertakes to write a book on volcanoes, should, there can be no doubt, regard them quite as much in relation to both the future and the past, as in their relation to the present; and, moreover, should be capable of regarding them quite as much from the standpoint of the astronomer as from that of a geologist. It is not easy to find such a man, and it may be long before any such Newton arises amongst the students of vulcanology. But Professor Bonney's wide experience as a lecturer and writer on geological subjects in general, and especially on the petrographical side of geology, gives him a claim to write with authority on the present subject which is stronger than most other men possess; and, assuredly, most people will be agreed that it is only to a geologist that such a task should be committed.

In planning the work, Professor Bonney begins by giving an account of a "living volcano," taking, as most of us would naturally do, Vesuvius as his type. Now that photography has made us familiar with almost every detail regarding this grand Neapolitan volcano, there is a peculiar fitness in the author's choice of this as his first example. He then takes us to the Phlegraean Fields, and gives us an account of the dormant and extinct volcanoes of that most interesting region. Then Stromboli is noticed as an example of an active volcano of a different type, while a brief account of the terrific eruption of Krakatau or Krakatoa serves as a description of an explosive outburst. Then follows a description of the quiet effusive eruptions of the Sandwich Island volcanoes, which are of so much importance to geologists, as illustrating the formation of extensive fields of gently-inclined lavas, such as characterise the plateau type of volcanic deposits.

One would naturally expect Professor Bonney to give an excellent account of the materials of volcanic rocks, and accordingly Chapter II. is devoted to this important part of the subject. It is very pleasant to find him (p. 66) entering a much-needed protest against the unnecessary introduction of new names for rocks, a practice which bids fair to land us before long into a state of chaos little better than that to which the nomenclature of ammonites has been degraded.

Next follows an account of extinct volcanoes, in connection with which are given some reproductions of Dr. Tempest Anderson's beautiful photographs of volcanic phenomena. Readers of Prof. Bonney's book will cordially agree with

the author in hoping that Dr. Anderson will shortly see his way to publishing a large number of these instructive and beautiful views.

Frequent references are made to Sir Archibald Geikie's "The Ancient Volcanoes of Great Britain" in this chapter. But surely Sir Archibald is not responsible for the statement made on p. 147, that most of the lavas on Arthur's Seat are "porphyrites." There is an excellent account in Chapter II. of the exposure of volcanic rocks on the Fifeshire coast, which are probably amongst the best examples of their kind in existence.

On pp. 162-164 the author makes some reference to the physical relations between the bounding surfaces of intrusive masses and those of the rocks they invade. In connection with this it is well known by many field geologists that this relation is one which indicates the replacement of the one by an equivalent volume of the other. Explain it how one may, there can be no doubt about the actual fact. Many readers will think that the author might have made some fuller reference to this especially interesting point, even if, in doing so, less had been said about the so-called "laccolites."

Chapter IV. gives an excellent summary of the chief points of interest connected with the oldest British volcanoes.

Then follows an account of existing volcanoes, considered mainly in reference to their geographical relations.

The concluding chapter, which is perhaps that which will prove of most interest to all, deals mainly with theoretical considerations. It may fairly be described as an admirable summary of the chief points of interest in this connection. As the reader puts the book down he cannot help feeling that if, here and there, his own way of viewing the facts may be somewhat different from the author's, yet the book as a whole is full of suggestive matter, and will form an admirable companion volume to the works of the best previous writers on vulcanology. J. G. G.

HISTORY OF NATURAL SCIENCE.

Grundriss einer Geschichte der Naturwissenschaften, zugleich eine Einführung in das Studium der grundlegenden naturwissenschaftlichen Litteratur. By Dr. FRIEDRICH DANNEMANN. 8vo. Leipzig: Engelmann.

Band I. Erläuterte Abschnitte aus den Werken hervorragender Naturforscher. Pp. xii. + 375, with 44 figs. 1896. Price 6 Marks.

Band II. Die Entwickelung der Naturwissenschaften. Pp. 435, with 76 figs. and a spectrum plate. 1898. Price 9 Marks.

In the young student's haste to gorge his brain with facts which are presented to him in abundance, and even in his maturer haste to hunt and discover for himself, little opportunity is left for an adequate appreciation of the history of science. Every one admits the grandeur of the historical development, and its importance is recognised by all who use the evolution idea as a formula in thinking, yet it seems impossible to avoid the confession that the historical aspect of science receives comparatively little attention in this country. In many a text-book there is, except in the bibliography, hardly a suggestion that the subject has had a history at all; in many a course of lectures it is the same; and the student receives his up-to-date science like a translucent and differentially-stained histological section dropped down on his slide by a demonstrator with a bowlful—a section so beautiful and clear, that in his saner moments the ingenuous beginner does sometimes wonder how it came to be as it is.

With the laudable aim of lessening this defect in our scientific education Dr. Dannemann has prepared the two volumes before us, which he modestly recommends to all interested in the methods and results of exact science. In the first volume, he pursues a very interesting and natural method, that of

giving a series of representative extracts from the writings of prominent workers, from Aristotle to Humboldt, sixty-two in all. To criticise these seems hardly fair without making a better selection of sixty-two, and this we have no desire to attempt. Just as in the case of a "Golden Treasury of Lyrics," one misses some old favourites, and wonders what possessed the editor to put others in, one misses anything from Harvey, Buffon, Lamarck, or von Baer, and how many others!—but room had to be found for Euler and Galvani, Wöhler and Carnot. Our disappointment is softened too when we come across Swammerdam and Trembley, Goethe, and Sprengel, Schwann and Schleiden. In short, though I daresay a man might have made a better selection of sixty-two samples, the fact is that no one ever did. Dr. Dannemann speaks in a quiet way in his preface of the book being useful to pupils in the upper forms of high schools, but shall we not be frank and admit that there is none of us—Herren Professoren, Doctoren, Privat-Docenten, and Gelehrten in general—who would not be the better of reading a book like this, and renewing our youth thereby.

The second volume is more ambitious and more open to criticism, to which we are averse. Its title is "The Development of the Natural Sciences," and we doubt whether the theme is within any one man's grasp, though Mr. Merz made a brave beginning in the first part of his "History of Scientific Thought in the Nineteenth Century" (1897). Dr. Dannemann divides his history into four chapters:—Ancient Times, The Middle Ages, The Later Times, and Modern Times.

In regard to the last—the scientific Plistocene—he notes especially the results of the theory of combustion and atomicity; the discovery of electricity and its consequences; the influence of Laplace and Herschel on astronomy; the further progress of chemico-physical research; the institution of the "natural system" in zoology and botany; the results of the establishment of the doctrine of the conservation of energy; the influence of chemico-physical research on biology and geology; and the evolution-doctrine. But this is far too much for about 100 pages; and although the author faces up manfully, we are afraid that it won't do. There should at least have been a separate volume for the Darwinian era, for with Darwin all things became new. We liked the book very much until we reached what we have called the Plistocene period, and then, if the erudite author will forgive us, we liked it very little. The task was too big for the pages. May we hope for a second edition in three volumes? The publisher, who has already the gratitude of the historically-minded by his issue of Ostwald's "Klassiker," should see to this.

J. A. T.

ENGLISH EDITION OF VERWORN'S GENERAL PHYSIOLOGY.

General Physiology: An Outline of the Science of Life. By MAX VERWORN, M.D., Ph.D., A. O. Professor of Physiology in the University of Jena. Translated from the Second German Edition, and edited by FREDERIC S. LEE, Ph.D., Adjunct Professor of Physiology in Columbia University. 8vo, pp. xvi. + 615, with 285 illustrations. London: Macmillan and Co., 1899. Price 15s.

As the first and second German editions of this important work have been already reviewed in *Natural Science*, we must restrict ourselves to welcoming the book in its English dress. And this welcome should be a hearty one, for the volume occupies an almost unique place as an introduction to the problems of general physiology, and has been widely appreciated for its lucidity and suggestiveness. As Mr. Lee says in his prefatory note, "Many of the special views of the author have encountered opposition—a fact that perhaps is indicative of their value—yet, however much we may agree or disagree with him

upon special points, we all must acknowledge his breadth and be grateful to him for presenting such a wealth of facts, and for pointing out so clearly the possibilities of research." Mr. Lee's translation is admirably done, and sustains the spirit and charm of the original. Opinions must of course differ in regard to particular phrases, *e.g.* "the mechanics of hereditary transmission" for "Vererbungsmechanik"; or "structure and liquid" for "Structur und Flüssigkeit"; but these are trivial matters when the whole book is so clear. A new feature of merit is the bibliography at the end, to which the references in the text are related by placing the year of publication after the author's name, a convenient method which makes its way slowly in Britain. There is still what seems an unnecessary repetition of the same figures in different parts of the book, and the German edition is followed in printing the names of classes and the like in the same type as names of species, which also seems to us a mistake. But these are paltry criticisms. What we have to do is to recommend with all possible heartiness this new edition of a book which many already know to be fascinating. X.

OPTICAL INSTRUMENTS.

Die Optischen Instrumente der Firma R. Fuess, deren Beschreibung, Justierung und Anwendung. By C. Leiss. Pp. xvi. + 397, 233 figures and 3 plates. Leipzig: Wilhelm Engelmann, 1899.

This book is one of a type unknown in British scientific literature. As its title indicates, it contains a full description of the optical instruments supplied by the well-known firm of Fuess. The question at once arises, How far can such a book be of use in an optical laboratory? The natural impression might be that its usefulness must be extremely limited, that it can be of little use to those who are furnished with the instruments of other firms, or even with those of Fuess which are not of the most recent construction. Yet this impression would be extremely false. All scientific instruments, which are designed for definite purposes, are designed upon definite principles. And in this book the principles are fully treated. The result is that variations in the details of construction are of little importance. The description is aided by no fewer than 233 elaborate figures.

There are many students and others, who, having become acquainted with the elements of physical science, desire a more complete acquaintance with the methods of physical research in order that they may follow more intelligently the progress of scientific knowledge, and who are unable to make themselves practically acquainted with these methods by work in a laboratory. To these, a book of this kind should be of great use.

CONDITIONS OF GROWTH.

Experimental Morphology, Part II.: Effect of Chemical and Physical Agents upon Growth. By C. B. Davenport. Vol. II. Pp. 281 to 509. London: Macmillan and Co., 1899. Price 9s.

This volume is the sequel to a previous one published two years ago, dealing with the effects of chemical and physical agents upon protoplasm; and in all respects the new-comer is the worthy partner of the first.

Mr. Davenport's work is of high importance. There is no other of the same type, dealing with the same matter from the same point of view. In the second place, the point of view is that of the "later biology" such as has taken form in the work of Roux and of the German school of which he is the very energetic and hard-working chief, and in the work of a number of zoologists, in the English-speaking countries principally, Mr. Davenport himself being *unus ex pluris* of the latter, and *pars non parva*, by his personal investigations.

"Experimental Morphology" is a very suggestive book—a book which gives

ideas, which opens new vistas, which suggests new experiments. To the neophyte it opens quite a new train of thought; it shows what ought to be done, what has been done, and what could and should be done. For, most certainly, Mr. Davenport's book is of the provisional and temporary sort: before ten years he will have to begin it again, adding to each chapter, and opening new chapters, if only we, his readers, do read him as we should, and take the hints which he gives at each page. This "if," however, is a mere "oratory precaution"; there is no doubt as to the future of experimental morphology; the number of workers in the field is steadily increasing.

The matters considered by Mr. Davenport in this second part of his book are all related to growth. Growth is an important subject-matter, practically as well as from the speculative standpoint, and it is a very important matter that the agencies which exert an influence on growth should be clearly recognised. The agriculturist and breeder are as much interested in this as the physician and biologist.

The agencies referred to are numerous, for "that property which protoplasm among all substances alone displays of increasing itself for an indefinite time and to an indefinite amount" is much influenced by external conditions: by chemical agents, by water, by the density of medium, by molar effects, by gravity, by electricity, by light, in brief, by complex agents; and each of these conditions is the subject-matter of a chapter in Mr. Davenport's book.

Generally speaking, of course, each chapter is a summary, an abstract of the work which has been done by various workers, the author himself often included, and a bibliographical list of references is the necessary complement of the text. It must be said that no important paper seems to have escaped Mr. Davenport's notice. However, in some cases, there are references which ought to be taken account of. In the chapter where the author speaks of the chemicals and of their distribution among organisms, no reference is made to Fliche and Grandeau's investigations concerning the chemical composition of various species of plants nearly related to each other; nor to recent investigations concerning the presence of copper in plants. Of course, some of the latter are too recent to have been included in the book, as they have been published only two months ago (in *Botanical Gazette*, by D. G. MacDougal); but others are of older date, such as those of J. B. Skertchly and Lehman; others are to be found in Schimper's recent *Pflanzen-Geographie*.

Concerning the effect of flowing water upon the direction of growth, I would also refer Mr. Davenport to a paper of Arnould Locard on the fauna of the water-pipes in Paris; the French malacologist observes that in the water-pipes, where the flow is rapid, *Dreissensia polymorpha*, which is abundant, relinquishes its curved form to become straight, and other mollusks—*Lymnaea*, for instance—assume a specially elongated form under the same influence.

And concerning the effect of light, and especially monochromatic light, some interesting facts are to be found in Finsen's investigations. The latter have been recently summarised and brought together in a pamphlet on Phototherapy.

It must not be inferred from the preceding lines that Mr. Davenport is not well informed; and while I refer him to the facts and papers mentioned, I only wish to give what help and aid a reader should always give an author when he meets with a carefully constructed work in which he takes a great interest. This is co-operation, not criticism.

A review of Mr. Davenport's book is hardly possible, in what space is available; it is so very analytical that, of course, every biologist should read it for himself, and make use of it for new experiments. There are any number of points which require new and full investigation. For instance, the influence of light. Retardation of growth is induced by light in most aerial plants, while in animals acceleration obtains; and in both cases the effect is due to the same rays, the chemically active. This is the general fact: a full study of the matter would certainly prove very profitable.

Very useful also would be an exact investigation of the period of life of any organism during which the influence of any agent would prove most effective—whether good or bad—on one system, or function, or organ.

But no one can read this book without perceiving, by what has been done, what remains to be done; it is an eminently suggestive work, and therefore it is as well to leave the reader to draw his own conclusions. We earnestly hope, for the sake of biology, that the book will be extensively read by the younger workers: most certainly it will open their eyes to new views, and push them in a field where much is to be done, and a good harvest reaped. Mr. Davenport deserves the thanks of all who are interested in biology.

H. DE VARIGNY.

"KORSCHELT AND HEIDER."

Text-Book of Embryology of Invertebrates. By Drs. KORSCHELT and HEIDER. Vol. II. (Phoronidea, Polyzoa, Brachiopoda, Crustacea, Palaeostraca.) Translated by M. BERNARD. Revised and Edited by MARTIN F. WOODWARD. Pp. xvi. + 370 and 165 figs. London: Swan Sonnenschein and Co., 1899. Price 12s.

If writing a text-book be a thankless task, the translating of a foreign text-book must be worse. In such a subject as embryology, the functional life of a text-book may be put down as about two years, so that a translation really requires to be practically re-written. An attempt has been made by Mr. Woodward to meet this want by the addition of footnotes, but we think it would have been better to have taken the bull by the horns and have re-written the whole. In some cases we find that a note by the revising editor at the end of a page or two of "general considerations" leads one to condemn the latter as "premature conclusions." This is specially evident in the first and the last groups dealt with, namely, the Phoronidea and Palaeostraca. From these remarks it will be seen that Mr. Woodward's notes add greatly to the value of the book in bringing it up to date and in reducing the relative antiquity of the work to a minimum.

A perusal of the discussions upon phyletic affinities leads a thinking zoologist to pause and consider whether zoological science is yet sufficiently advanced for the determination of these relationships. Do we not require to definitely settle what features are to be regarded as of phyletic value? We find the authors arguing for the unity of the Molluscoida as a natural group, firstly, on account of structural resemblances (pp. 84 to 88) which, if one allows for similarity of habitat, resolve themselves into a well-developed coelom with similarly related divisions. The absence of a true coelom again assists the authors in isolating the Entoprocta though they commence their discussion of the Phoronidea by the remark:—"The Actinotrocha may without difficulty be regarded as a somewhat modified Trochophore." This becomes modified later into (p. 86) "The Actinotrocha type is distantly allied to the Trochophore larva, being distinguished from the latter chiefly by the presence of a true coelom," and this "distant alliance" from Brachiopoda through Actinotrocha to Trochophore is used as an argument against the comparison of the former with *Sagitta*. The structural resemblances between Brachiopoda and Chaetognatha are dismissed as "analogies," and their differences "in manner of life" are quoted against genetic affinity! Surely structural resemblances combined with differences in habitat would form the strongest arguments for genetic affinity.

The immense number of facts and observations clearly set forth will place this "Embryology" in a unique position, and the work of translation has been ably and fluently effected. All the diphthongs are abolished, and such words as "zoaea," "coelom," "Palaeostraca," "zooecium," and "caenogenetic" have a

peculiar appearance to some eyes, though not to readers of *Natural Science*. We may also note "oral and anal apertures" for mouth and anus, "Phoronidae" for Phoronidea, "epistomal" for epistomial, "endosternum" for endosternite, and "intestineless" for anything more euphonious. Such terms as "unicorneal" and "primary coelom" also require amending.

The illustrations are numerous and good, and in instances of the contrary, such as Fig. 8, Mr. Woodward's notes save misunderstanding. In this connection, however, the caricature of *Cephalodiscus* on p. 89 should have been excised.

In making these critical suggestions we do not wish to lose sight of the outstanding merit of the work and the great benefits which the translator and editor have bestowed upon British zoologists by their labours, which, considering the nature of the task before them, could hardly have been more satisfactorily accomplished. We heartily congratulate them on the production of this volume, which must tend to make "Korschelt and Heider" more readily accessible to a number of embryological workers who have not the time, and in many cases the training, to follow the authors in the original.

A. T. MASTERMAN.

THE GEOLOGY OF SOUTH AFRICA.

Bibliography of South-African Geology. Compiled by H. P. SAUNDERS, Secretary to the Geological Commission. 8vo, 56 pp. South-African Museum, Cape Town, 1897.

Cape of Good Hope Geological Commission, Department of Agriculture. First Annual Report (for 1896). Large 8vo, 52 pp., and 2 plates, 1897. Second Annual Report (for 1897), 86 pp., and 2 plates. Richards and Son, Cape Town, 1898.

We gladly welcome these first-fruits of the Geological Survey of the Cape of Good Hope Colony, established in 1895. The official work of Dr. G. S. Corstorphine, and his assistants, A. W. Rogers and E. H. L. Schwarz, has been especially directed to the elucidation of the structure and physical features of the south-western part of Cape Colony. This includes the Divisions of Robertson and Worcester, and parts of Stellenbosch, Prince-Albert, Ladismith, and Swellendam; or, in other words, "from the west coast eastwards to the Gamka River, and from the Zwartebergen, on the north, to some distance south of the Langebergen; while the Malmesbury district has been completed north to St. Helena Bay." This area exhibits the following formations in *ascending* order:—

1. Malmesbury Beds.—Non-fossiliferous slates, phyllites, mica-schists, and quartzites, with intrusive granite, quartz-porphyry, and diabase.
   (Marked unconformity with the next exists.)
2. Table-Mountain Sandstones.—Sandstones and quartzites, with occasional shales.
3. Bokkeveld Beds.—Fossiliferous shales, sandstones, and greywackés.
4. Witteberg Beds.—Mainly quartzites (often with alga-like markings).
5. Dwyka Series.—Conglomerate and interbedded shales.
6. Ecca Beds.—Shales and sandstones, with occasional plant-remains.
7. Superficial deposits.—Gravels, sands, conglomerates, sandstones, and limestones.

The Surveyors have arrived at some new and valuable conclusions, determining the exact relationships of the Malmesbury and Ecca Beds in the Worcester Division, and of the Table-Mountain Sandstone in the Langeberg and Zwarteberg ranges. The great amount of folding to which the strata have been subjected, particularly in the mountains above mentioned, and in the Hex-river mountain, and the extensive dislocation, such as the "Worcester-Robertson"

fault, which has "the enormous downthrow of at least 9000 feet to the south," have been carefully worked out, and are clearly shown in the geological map and sections.

The Surveyors have conscientiously compared the notes and descriptions by earlier observers with the sections and other features which they themselves have studied and illustrated with precision. Being well-trained geologists they have drawn valid conclusions; for the most part confirming and enlarging those arrived at by A. G. Bain and other early observers. Mr. Saunders's *Bibliography* is a great help in referring to what has been published since 1841 (Clarke), 1844 (Darwin), 1845 (Bain), etc.

Summaries of local work by Messrs. Rogers and Schwarz are given in the First Report. A good map, with sections, illustrates the distribution of the dolerites in the Nieuweld Mountains, as described by Mr. Schwarz in his account of the district of Beaufort-West. There is also an elaborate sketch-plan, by Dr. Corstorphine, of the Cango Cave in the dolomite, near Oudtshoorn, south of the Zwartebergen.

In the Second Report a very welcome geological map of the district already surveyed (as defined above) is given, on a scale of 1:800000 (1 inch to 12·62 English statute miles), in Plate I. Five long and very instructive geological sections, from north to south, on a scale of 1 inch to 1·878 miles, or 800 Cape roods, are given in Plate II. In this Report Mr. Rogers gives an account of the Survey of the Stellenbosch district, and Mr. Schwarz that of the Robertson and Swellendam Divisions; and both together draw up a summary of the work done during 1897 in the area between the Langebergen and the Karoo. Here occur the Table-Mountain Sandstone, the Bokkeveldt and Witterberg Beds, the Dwyka Series, and the Ecca Beds; more especially illustrated in Sections 3, 4, and 5 of Plate II. The Dwyka Series of shales and conglomerates, lying conformably on the Witterberg quartzite, in particular is described, Mr. E. J. Dunn's careful notes being largely incorporated. The glacialised condition of the materials of the conglomerate is accepted; these are pebbles and fragments of "several varieties of granite, . . . several kinds of more basic igneous rock, sandstones, quartzites, argillaceous and calcareous rocks, and vein-quartz. Under the microscope the matrix is seen to consist of "minute fragments of anisotropic substances, . . . with quartz, felspar, . . . garnet, epidote, augite, . . . white and brown mica, sphene, magnitite, . . . calcite, as pebbles and grains, and as a secondary product." Included in the Dwyka Series are some peculiar superincumbent shales and sandstones, succeeded by black graphitic and pyritous shales; above these are the conformable Ecca sandstones and shales, containing plant-remains, and lying in folds parallel with the mountains, Zwartebergen, etc., on the south. To the north the great Karoo Series is present, and, together with the Eastern Province, will be reached by the Survey in due course.

At pages 37-43 Dr. Corstorphine supplies an interesting and philosophical review of the geological history of the successive formations constituting the country which the Geological Survey as yet has been able to determine and describe.

T. R. JONES.

SCIENCE FOR THE YOUNG.

Early Chapters in Science. By Mrs. W. AWDREY. Edited by W. F. BARRETT. 8vo, pp. xviii. + 348, with figs. London: John Murray, 1899. Price 6s.

The object of this book, writes Prof. Barrett, is to provide young people, especially the junior classes in schools, with an introduction to the two great divisions of science—Biological and Experimental—to the World of Life and the World of Experience—and, in a word, to cover the ground of Mr. Paul Bert's "First Year of Scientific Knowledge" in a more attractive

style and a less indigestible manner. The various sections have been revised by specialists—all Dublin men—whose labours are gratefully acknowledged; and the claim of the editor that the young reader will not have much to unlearn is fully justified. The style is fluent, yet not diffuse; the facts are well selected and well expounded. The zoology is particularly interesting, and contains a new parrot story of distinct merit. The figures are poor, shaded, yet without the least perception of tone-relation, like those of a century ago. Yet they are not without some spirit: the leary lemur, the supercilious tapir, and the 'orty proud gazelle, will be attractive to children; but the tusks of the hippopotamus are drawn *outside* the upper lip; the lion (*passant*) has a true heraldic air; and the "baboon," which will suggest a toy-shop poodle to the child, recalls to ourselves the illustrations to the old editions of Marco Polo or Sir John Maundeville. Again, of the three very bad figures of vegetable histology, that called "woody tissue" is easily worst, and a gratuitously useless disfigurement to the beautifully printed text. The paper is unduly thick, and the physical weight of the book (1 lb. 5 oz.) excessive; while the sheets are so carelessly stitched that it opens badly and will soon fall to pieces, just because of the merits of the letterpress. M.

THE SECRET OF LIFE.

Die Kontinuität der Atomverkettung, ein Strukturprinzip der lebendigen Substanz. By Dr. GEORG HÖRMANN. 8vo, pp. 118, with 32 figures. Jena: Gustav Fischer, 1899. Price 3 marks.

The aim of this pamphlet is defined by the author to be the application of Pflüger's hypothesis of the chemical continuity of protoplasm to various biological problems, with the view of showing that it renders these more readily comprehensible than any other hypothesis. Pflüger emphasised the power of polymerisation displayed by many organic substances, and suggested that in the living organism this might go on indefinitely so that great masses might arise, and the whole nervous system, for example, might be built up of a single giant molecule. Accepting this suggestion in its entirety, the author seeks in a series of chapters to show that it renders explicable such phenomena as the propagation of stimuli along a nerve, the effect of nerve section, the action of electrical organs, and so on. The pamphlet is illustrated by numerous ingenious and complicated diagrams, and may be recommended to those persons to whom such phrases as the "principle of chemical continuity" appeal strongly; to others we fear much of it will seem vanity and vexation of spirit. As in so many similar cases it is difficult to find out whether the author regards the hypothesis as merely of value in the construction of mental pictures of the more complicated phenomena of life, or whether he seeks to explain these phenomena in terms of chemistry and physics. We have noted what seems an excessive number of misprints, and cannot congratulate the author upon his style, which is not calculated to assist in the comprehension of a difficult subject. N.

HISTORY OF ASTRONOMY.

A Short History of Astronomy. By ARTHUR BERRY, M.A. 8vo, pp. xxxii. + 440, with 105 illustrations and nine portraits. (University Extension Manuals, edited by Professor Knight.) London: John Murray, 1898. Price 6s.

Unlike several books which have appeared within the last few years, in which the principal events of the history of astronomy have been described in the form of biographical sketches, the present work seeks to present the reader with a complete account of the historical development of astronomy without giving undue prominence to the biographical element. It is evident that Mr. Berry has most carefully prepared himself for his task not only by reading the

larger general works on the subject, but also by studying the chief monographs which have appeared on special periods, and also to some extent the original works of the great men who have guided science into new paths. The book does not suppose the reader to possess any (or at least but a very slight) previous knowledge of astronomy, and accordingly the first chapter, on "Primitive Astronomy," describes the celestial sphere and its principal phenomena. In the next chapter, on "Greek Astronomy," the pre-Alexandrian period might perhaps have been more fully dealt with, and here it appears that the author is not so well acquainted with monographs and special studies (*e.g.* those of Ideler, Schiaparelli, and others) as he generally seems to be. That he confounds Herakleides with Herakleitus is perhaps due to his having depended too much on Wolf. The account of the Alexandrian astronomy is clear and correct, and the same may be said of the following periods. Throughout the author gives a very correct picture of the state of science at the time under consideration, while his book is not only accurate but at the same time extremely readable. The astronomy of the last two hundred years occupies exactly half the volume, and both "gravitational," "observational," and "descriptive" astronomy are passed in review. The two latter departments are perhaps not quite so thoroughly discussed as the first one, and especially it seems strange that next to nothing is said about instruments. The numerous illustrations (including nine excellent portraits) are well chosen, and in many cases borrowed directly from the original works of Copernicus, Galileo, etc. Not only as a University Extension Manual, but also as a book suitable both for the general reader and for the more advanced student, the work deserves every commendation.

J. L. E. D.

A TEXT-BOOK OF GENERAL PHYSICS.

A Text-Book of General Physics for the Use of Colleges and Scientific Schools. By C. S. HASTINGS, Ph.D., and F. E. BEACH, Ph.D. 8vo, pp. viii. + 768, with 495 figs. Boston: Ginn & Co., 1899. Price, 2 dollars 95 cents.

The reputation of the two Yale Professors led us to expect a thoroughly sound and interestingly written text-book on physics; and our hopes have been to a large extent realised. The book looks well, is finely illustrated, and contains some interesting novelties of treatment. How far the introduction of such novelties into an avowedly elementary book is expedient is a matter on which there will probably be great difference of opinion. Again, we very much question the wisdom of giving, *necessarily* without proof, Clausius' expression for the virial of a gas, evidently as a stepping-stone to an indication of how Van der Waals arrived at his famous equation, which after all is only of limited applicability. The chapter devoted to oboes, clarinets, French horns, saxophones, etc., might with advantage have been omitted, and the space utilised to far better purpose. The arrangement of the book is a little peculiar, and leads to the awkwardness of discussing electro-magnetic waves before waves in general have been taken up. In short, the interpolation of electricity and magnetism between elasticity and sound has nothing to commend it. There is also an unfortunate inversion in discussing magnetic induction and hysteresis before any account is given of electro-magnetism. These faults in arrangement may perhaps be covered by the statement in the preface that "the book as a whole is designed as an aid to the teacher," and "assumes as a necessary complement a course of [experimental] demonstrations." In other respects there is much in the book that is worthy of praise, one interesting feature being the use the authors make of the wave-front in discussing optical theories and applications. Students who have already gained some knowledge of physical facts and theories will find their grip of the subject strengthened by a careful perusal of this text-book, while the teacher will probably receive hints of no small value.

C. G. KNOTT.

PHYLOGENY OF PLANTS.

Lectures on the Evolution of Plants. By DOUGLAS H. CAMPBELL, Ph.D. 8vo, pp. viii. + 319, 60 figs. London and New York: Macmillan and Company, 1899. Price 4s. 6d. net.

It is difficult to refrain from effusiveness in welcoming this book. Prof. Campbell has accomplished the feat of writing a botanical book which may be read right through by the merest zoologist or cultivated reader, and this with profit. His account of the vestiges of the evolution of plants—rather than of the evolution of plants—is admirable from all points of view. It would be absurd, of course, to claim that his opinions, or anybody's opinions, would receive a general assent, but the reader who wishes to get a general idea of what botanists think at the present day of the line of descent and succession of forms could not do better than read these lectures. He will perhaps unconsciously absorb a deal of good botany at the same time. As for Prof. Campbell's views one may summarise them in a few words. He thinks it "not unlikely that the separation of the two great branches of organisms, plants and animals, took place among the Flagellata." He regards the ciliated Volvocineae as primitive forms from the very frequent reversion to this condition exhibited by higher plants in their reproductive cells. The Chlorophyceae may be assumed to have given rise to the Bryophytes—the Phaeophyceae and possibly even the red Algae constituting an independent developmental line. The Archegoniate plants in general find their ancestors in the Hepaticae. Of the seed plants the Gymnosperms are obviously the lowest types, though it is not likely that they constitute a homogeneous class. "It is much more probable that they represent the remnants of two, and possibly more, quite distinct developmental lines. The cycads show close affinity with the true ferns, while the conifers recall more strongly the Lycopods."

There are few books of general botanical interest better worth reading than Prof. Campbell's excellent "Lectures." G. M.

MILK.

Milk: Its Nature and Composition. A Handbook on the Chemistry and Bacteriology of Milk, Butter, and Cheese. By C. M. AIKMAN, M.A., B.Sc. 2nd Edition. Crown 8vo, pp. xx. + 180, illustrated. London: A. and C. Black, 1899. Price 3s. 6d.

The author's preface tells us that the aim of the volume is to give a short popular statement of the more important facts of the chemistry and bacteriology of milk. The book is essentially one made from books, and contains much useful information of a sketchy kind about milk, its various products and composition. Unfortunately, one finds that much of the information inserted in the chapters on bacteriology, which occupy 50 pages of the 174, has not been weighed by a competent authority. For example, it is indicated that tuberculosis is largely spread to human beings by milk. One also finds ridiculous statements such as, that Prof. M'Fadyean says "that one calf in every four is born tuberculous," that diphtheria and scarlet fever are transmitted directly from the cow to man, that the microbe of diphtheria has not been isolated, and that of all media milk is the best for growing microbes. These and other serious errors might easily have been avoided by exercising a little more care in compilation. S.

The Story of the Mind. By JAMES MARK BALDWIN. London: George Newnes, 1898.

Prof. Baldwin has given in this little book a pleasantly written series of chapters on psychology in its introspective, comparative, physiological, experimental, educational, and social aspects. The work closes with an essay on the genius and his environment. There is a well-marked personal note throughout, since many of the illustrations are taken from the author's own investigations; but this is quite in keeping with the form in which the work is cast. The only criticism that we feel called upon to make, is, that the book does not fulfil the promise of its title as we understand it. It does not present us with a continuous story of the mind, but with a somewhat discontinuous series of short essays on psychological methods and results. But it has good points.

Bryotheca Bohemica is a set of exsiccati, now being issued, at a price of 14 marks per century, by Dr. Ernst Bauer (of Smichow bei Prag, N.C. 961) in co-operation with Dr. V. Schiffner and others.

Professor Simon Schwendener, of Berlin University, has collected thirty-one of his botanical papers in two octavo volumes issued by Borntraeger, Berlin, at a price of 25 marks. The papers are reprinted without other alteration than that of printers' errors and mistakes in the calculations, and with the addition of a few notes. Reference is given in each case to the original place of publication, and reference will have to be made by the student in each case since the original pagination is not given. Except for this, all botanists will be glad to have these valuable memoirs in convenient form.

From June 1898 to March 1899, Mr. F. A. Bather communicated to the *Geological Magazine* a series of six illustrated articles on Wachsmuth and Springer's Monograph of "The North American Crinoidea Camerata." Since these contained more original matter than one looks for in a review, they have been furnished with an index and published in pamphlet form by Messrs. Dulau and Co., at the price of two shillings. The reprint also contains a portrait, obituary notice, and bibliography of Charles Wachsmuth.

The first fourteen pages of the *Proceedings of the Washington Academy of Sciences* were issued on April 14. They consist of the "First annual report of the Secretary," by G. K. Gilbert. This gives a history of the gradual multiplication and specialisation of scientific societies in Washington, and their eventual federation under an Academy in February 1898. The affiliated societies, nine in all, are: the Anthropological, Biological, Chemical, Entomological, Geological, and Philosophical Societies of Washington, the National Geographic Society, the Columbian Historical Society, and the Medical Society of the District of Columbia. The President is J. R. Eastman. A plan for the selection and printing of papers has been carefully matured, and accepted papers will soon go to press. It is intended to conduct courses of lectures, and to hold occasional meetings for the reception of new scientific material. It is probable that one of the chief functions of the Academy will be to act as an advisory body to the United States Government on questions involving scientific knowledge.

Science Work for April reproduces in good style an excellent photograph of the Scuir of Eigg, taken from E.S.E. by Mr. A. S. Reid, who has taken a complete series of views illustrating the geology of the island, for the Geologist Photographs Committee of the British Association. This journal now bears the imprint of Messrs. Dawbarn and Ward, the publishers of the *Photogram*.

An interesting comparison of the eyesight of Europeans and "natives" (Kaffirs, Hottentots, Basutos, etc.) has been made by Dr. Beheim, and is published

in the *African Review*. Out of a total of 1853 natives, 1509 had a vision equal to the normal vision of Europeans, 257 were above, and 87 below the average. This bears out what was indicated by Mr. Hudson in one of his interesting essays.

In the *Scientific American* for April 15, there is a note by Mr. Charles H. Coe, to the effect that the honey-bee was probably introduced by the Spanish settlers in Florida, for Bartram, who explored the country in 1773, mentions honey and beeswax as articles of barter among the Indians.

In the May number of our ably-edited contemporary *The Veterinarian*, which is probably less known to biologists than it should be, we find a note to the effect that Baron de Parana, of Porto do Cunha, Rio de Janeiro, has now succeeded in getting five zebra hybrids between a true Burchell's zebra and mares.

OBITUARIES.

JOSEPH WOLF.

BORN 1820; DIED APRIL 20, 1899.

WE regret to record the death of Joseph Wolf, the artist and painter of animals, who has been for so many years prominently before the zoologist and the general public. Wolf was born near Coblentz, was early apprenticed to a lithographer in Antwerp, and was "discovered" by Hermann Schlegel. He came to England in 1848, and was soon accepted by painters of all ranks. His studio became a rendezvous, and he numbered among his friends everyone worth knowing among the explorers, zoologists, and artists. Wolf's work is best known through his illustrations to books, and of these Gray's "Genera of Birds," Gould's "Birds of Great Britain," and his own "Life and Habits of Wild Animals" are well known. A very fine series of his drawings is to be found in the apartments of the Zoological Society of London, and many of the plates in the *Proceedings* of this Society and of the Linnean Society, between 1850 and 1870, are by him. He was engaged only just before his death in correcting the proofs of an article by Mr. Trevor-Battye upon his work for the *Artist*. His life, by Mr. Palmer, appeared a short time ago.

SYLVANUS CHARLES THORP HANLEY.

BORN JANUARY 7, 1819; DIED APRIL 5, 1899.

THIS well-known conchologist of the older school began to publish in 1840, his first work being "The Conchologist's Book of Species." This was followed rapidly by "A Catalogue of Recent Bivalve Shells," English edition of Lamarck's "Species of Shells," 1843; "Index Testaceologicus," 1856, with W. Wood; "Ipsa Linnaei Conchylia," 1855; and "Conchological Miscellany," 1854-58. He brought out the second edition of Swainson's "Exotic Conchology," combined with Edward Forbes on a "History of British Mollusca," and was the author of many minor papers. He was a B.A. of Oxford (Wadham College), lived for many years in Hanley Road, Hornsey Rise, London, and died at Penzance.

JABEZ HOGG.

BORN APRIL 4, 1817; DIED APRIL 23, 1899.

FEW names are more familiar in microscopy than that of Jabez Hogg. Born at Chatham, he was educated at Rochester Grammar School, and in 1843 joined the staff of the *Illustrated London News*. In 1845 he entered as a student at Charing Cross Hospital, becoming M.R.C.S. in 1850, and taking up practice in ophthalmology; was at the time of his death consulting surgeon to the Royal Westminster Ophthalmic Hospital. He was a prominent Freemason, receiving

from the Prince of Wales in 1889 the office of Grand Sword-Bearer in Supreme Grand Chapter. Hogg was best known to zoologists for his "The Microscope," of which the first edition appeared in 1854, and the fifteenth in 1898. Among his other works are "Manual of Photography," 1845; "English Forests and Forest Trees," 1853; "Colour Blindness," 1863. He was also the author of numerous papers on the eye, and conducted an investigation into arsenical wall-papers, the results of which he published. He died at Palace Gardens Terrace, London.

GEORGE CHARLES WALLICH.

BORN NOVEMBER 16, 1815; DIED MARCH 31, 1899.

WALLICH was born at Calcutta. His father, Nathaniel, was well known as an Indian botanist. George was educated at Edinburgh University, became M.D. 1836. He entered the Indian army in 1838, and served in the following campaigns: Sutlej, 1842; Punjab, 1847; and Southal, 1855. He retired in 1859.

The author of numerous papers, Wallich's especial claim to remembrance is his "North-Atlantic Sea Bed," 1862, in which was proved conclusively the existence of organic life at great depths in the ocean, depths which since that time have been far surpassed. He contributed some twenty papers to the literature of the Protozoa, establishing the remarkable genus *Rupertia*, and he was the first to throw suspicion on the organic nature of "Bathybius."

HEINRICH KIEPERT, 1818-99.

HEINRICH KIEPERT, whose death was announced at Berlin on April 22, was one of the most distinguished geographers of his time. Born in Berlin in 1818, he was a member of that University, to which he returned in 1859 as Professor of Geography, after a few years of labour in the Geographical Institute of Weimar. His especial subject was South-Eastern Europe and Western Asia, of which parts his maps were authoritative and masterly; at the same time he devoted much attention to the ancient world, and contributed largely to the elucidation of its cartography. His Asia Minor was perhaps his masterpiece.

FRANZ VON HAUER.

BORN JANUARY 30, 1822; DIED MARCH 21, 1899.

THE director of the Vienna Museum was born in Vienna, and was the son of Joseph v. Hauer, Vice-President of the Chamber. He was educated in Vienna, and obtained his technical knowledge of geology in the Berg-Akademie of Schemnitz. In 1843 he spent some time at the ironworks of Steiermark, and in 1844 was called to the Haidinger Museum in Vienna. Becoming assistant to Haidinger in 1846, he published his first paper *Die Cephalopoden des Salzkammergutes*. He became attached to the K. K. Geologischen Reichsanstalt in 1849, and was employed surveying in all parts of the Monarchy till 1867, when, on the retirement of Haidinger, v. Hauer became director of the Reichsanstalt. In 1886 he was appointed superintendent of the Natural History Museum in Vienna. Von Hauer published many papers, and was responsible for an important geological map of the Austro-Hungarian Monarchy in twelve sheets (Wien, 1867-73), the fourth edition of which appeared in 1884.

SIR FREDERICK M'COY, K.C.M.G., F.R.S.

BORN AT DUBLIN, 1823; DIED AT MELBOURNE, 1899.

FREDERICK M'COY was educated for the medical profession at Dublin and Cambridge, but early devoted himself to natural science. Sir R. Griffith invited him to make the palaeontological investigations for the geological map of Ireland for the boundary survey, the results of which he published in 1844. Afterwards he joined the Geological Survey of Ireland. In 1854 he was appointed the first Professor of Natural Science in Melbourne University. His services to Victoria were great, notably in regard to the geological survey of the colony, as a member of various commissions, and as the founder of the Melbourne National Museum. In 1880 he was elected F.R.S., and was one of the first to receive the honorary degree of D.Sc. from Cambridge. In 1886 he was made a C.M.G., and in 1891 he was promoted to be K.C.M.G. Sir F. M'Coy also received the Order of the Crown of Italy from King Victor Emanuel, the Emperor of Austria's gold medal for arts and sciences, the Murchison medal of the Geological Society of London, and many similar distinctions.

The deaths are also announced of MARIANO DE LA BÁRCENA, director of the Central Meteorological Observatory, Mexico; on May 1, in his 75th year, Dr. LUDWIG BÜCHNER, of Darmstadt, the famous author of "Kraft und Stoff" (1855), and many books and papers on evolutionist subjects; Dr. C. BRONGNIART, Paris, well known for his entomological work, especially on palaeozoic insects; on April 1, at Halifax, HENRY THOMAS SOPPITT, fungologist and field-naturalist, in his 41st year; ADOLF WALTER, a well-known ornithologist, at Kassel, on February 4, in his 82nd year.

NEWS.

THE fifteen candidates selected by the Council of the Royal Society to be recommended for election into the Society this year are:—Prof. W. F. Barrett; Mr. Charles Booth; Surgeon-Major David Bruce; Mr. H. J. H. Fenton, M.A.; Mr. J. S. Gamble, M.A.; Prof. A. C. Haddon; Dr. Henry Head; Principal C. Lloyd Morgan; Mr. Clement Reid; Mr. H. S. H. Shaw; Dr. E. H. Starling; Prof. H. W. L. Tanner; Mr. R. Threlfall; Mr. A. E. Tutton; and Prof. B. C. A. Windle. As will be seen, natural science is well represented, and *Natural Science* also.

Among the five new members of the U.S. National Academy of Sciences are C. E. Beecher, the palaeontologist, and E. B. Wilson, the embryologist.

On April 27, at Cambridge, Prof. Sir William Turner and the Rev. Prof. Thomas Wiltshire, were presented for the honorary degree of Doctor in Science.

The M'Gill University of Montreal has conferred the degree of LL.D. on Mr. Rudyard Kipling.

The gold medal of the American Geographical Society has been awarded to Sir John Murray, K.C.B.

Both the gold medals of the Royal Geographical Society have this year been awarded to Frenchmen. The recipients are Captain Binger and Mr. Foureau. The former is well known for his work in West Africa, particularly his exploring of the Kong country and of the vast and important area within the great bend of the Niger. The other medallist, Mr. Foureau, is at present engaged on a mission in the Sahara as one of the leaders of the Foureau-Lamy expedition. He has done more, perhaps, than any other man to add to our knowledge of the Sahara. The minor awards are four in number, and of these one goes to the Swedish naturalist, Dr. Nathorst, for his exploration of the Spitzbergen Islands and the seas between Spitzbergen and Greenland; another to the Hon. David Carnegie for his journey across the great interior desert of Western Australia, described in his recently published book, *Spinifex and Sand;* a third to Mr. Albert Armitage for his scientific work with the Jackson-Harmsworth Arctic Expedition; and the fourth to Captain Sykes for three journeys in Persia, during which he made important corrections and additions to the map of that country, and has done much to clear up the geography of Marco Polo.

Albert Lindström has been appointed honorary professor of anatomy at Stockholm.

The fourth Annual Congress of the South-Eastern Union of Scientific Societies was held at Rochester from May 25 to 27, 1899, under the presidency of Professor G. S. Boulger.

The Ealing Natural Science and Microscopical Society are making a collection of lantern slides to promote the study of natural science. They hope to obtain

such slides as shall illustrate definite subjects, such as the "Structure and Life-History of Plants and Animals," "Vulcanology," "Geology," "Astronomy," "Physics," "Local Phenomena of Scientific Interest," etc. The loan of negatives to make slides from will be of considerable value. Mr. B. B. Woodward, 120 The Grove, Ealing, W., will be glad to hear from any one interested.

At a meeting of the Geologists' Association on May 5, a paper on "The Drainage of Cuestas," by Professor W. M. Davis, of Harvard, was communicated. The paper dealt with the unsymmetrical longitudinal uplands (such as the Oolites and Chalk give rise to in this country) characterising certain denuded coastal plains, to which the author proposes to apply the distinctive term "cuestas." He discussed (1) the development of these topographical features, (2) the evolution of their drainage, and (3) the significance in this relation of certain details of valley form, especially as exhibited in the Swabian Alp of Würtemburg and the Cotswold Hills.

At the annual session of the U.S. National Academy of Sciences, which opened in Washington on April 18, communications were submitted on the Tawner deep sea tow net, by Alexander Agassiz; on the Acalephae of the East Coast of the United States, by Alexander Agassiz and A. G. Mayer; on "Palolo," by W. M'M. Woodworth; on *Ophiura brevispina*, by W. K. Brooks and C. Grave; and many others.

The Canvassing Committee of the Birmingham University has informed Mr. Chamberlain that the conditions attached to the gifts of Mr. Carnegie and the anonymous donor had been fulfilled, the subscriptions having reached £254,580. The anonymous donor, recognising that an endowment of a quarter of a million, although sufficient for a start, must soon be largely augmented, has also offered to contribute the last £12,500 if the fund were raised to £300,000 by the end of June. It was decided to make an appeal to the people of the city and district for the amount necessary to secure this additional offer.

Science announces the following gifts:—Mr. W. K. Vanderbilt has given 100,000 dollars to Vanderbilt University to build a new dormitory; and Miss C. W. Bruce has given 10,000 dollars to Columbia University for the astronomical department.

Applications for the Jodrell Professorship of Zoology in University College, London, vacant by the appointment of Prof. Weldon to the chair in Oxford, are invited by June 5.

Among the subjects of lecture and discussion at the annual meeting of the German Zoological Society convened in May at Hamburg, we notice:—The Hamburg Museum (Prof. K. Kraepelin); the scope of natural selection (Prof. L. Plate); Atolls and their Plankton (Dr. A. Krämer); Arctic and Antarctic faunas (Dr. G. Pfeffer); the statistical study of variation (Dr. G. Duncker); the development of *Bdellostoma* (Dr. F. Doflein); all of them most interesting subjects.

The *American Naturalist* notes that nearly forty applications were received for a special four weeks' course of instruction on poultry culture, held in January of this year at the R. I. College of Agriculture and Mechanical Arts (Kingston).

The biological laboratory of the Brooklyn Institute of Arts and Sciences at Cold Spring Harbour, Long Island, will be open for its tenth session during July and August 1899. Courses are offered by Dr. C. B. Davenport, Professor H. S. Pratt, Professor C. P. Sigerfoos, Dr. D. S. Johnson, Professor F. O. Grover, Mr. N. F. Davis, and Mrs. G. C. Davenport. Opportunities will be afforded for original work, especially on variation. The laboratory is equipped with a naphtha launch, bacteriological apparatus, and a good working library.

Boarding accommodation is provided. Applications may be made to Professor F. W. Hooper, 502 Fulton Street, Brooklyn, N.Y., or to Dr. C. B. Davenport, the director of the laboratory, Harvard University, Cambridge, Mass.

In connection with the housing of London University at the Imperial Institute, it is reported that the Government will arrange to take over the titles of the building, so that the University will be tenants of the Exchequer and not lodgers of the Institute.

The colonies of the West Coast of Africa have adopted a scheme whereby picked boys shall be sent for training in horticulture and economic agriculture, first to Jamaica and afterwards to Kew Gardens. This scheme is due to the success that attended the experiment initiated by the then Governor, Sir A. Moloney, of sending in 1890 two native lads from Lagos to be trained as gardeners at the Jamaica and Kew Gardens. After spending two years and a half in Jamaica, they were attached to Kew Gardens for some months, and are now in charge of branch botanic stations in Lagos, growing and preparing agricultural products, and giving instruction.

The *Scientific American* records the wreck in Magdalena Bay of the schooner "Ella Erland," and the consequent unfortunate end of a small expedition under Professor A. W. Anthony. But the naturalists on board, who had intended to study the fauna and flora of the equatorial Pacific coast, escaped with their lives at least, and have returned in safety.

Two new buildings in the new Zoological Park of New York are rapidly nearing completion. These are the reptile house and the winter house for birds. Much work has also been accomplished upon the various outdoor animal dens. In a hollow in the park is a body of water which will be utilised for aquatic rodents. The beaver pond is also ready, while up on the elevated portions among the rocks, work on the bear dens is well under way.

On the occasion of Spallanzani's centenary, celebrated recently at Scandiano, a laboratory was inaugurated to commemorate and continue his work. Professor Luciani of Rome and others delivered commemorative addresses.

We are pleased to learn that *Science Gossip* is to be enlarged. This is the result of the success with which Mr. Carrington has carried out the editorial work. Among other changes we note the appointment of Miss Flora Winstone as assistant editor. Miss Winstone for several years past has assisted largely with the editorial work, and in the absence of the editor abroad has on several occasions taken sole editorial charge of the magazine.

We have heard that there are adequate physiological reasons to account for the absence of blue roses, and we have not pined for them. It is not, therefore, with either faith or hope that we read the report of the Vienna correspondent of the *Standard* that an azure-blue rose has been produced in Kezaulik, the Valley of Roses, in Bulgaria.

The results of the Geodetic survey of the United States, which has been in progress for over fifty years, are to be published immediately. Measurements, such as the total distance across the Continent (2625 miles) will be known so exactly that the error will be less than 100 feet. In making this survey many stations have been used at altitudes of 10,000 to 14,000 feet, necessitating the application of new formulae.

A new Arctic expedition will soon sail from St. John's, Newfoundland, under the charge of A. Barclay Walker, an English yachtsman. Mr Walker intends to cruise in Arctic waters in the "Dundee," a steam whaler, during the next six months, with a party, including representatives of the Smithsonian Institution. They will probably attempt to reach the headquarters of Lieut. Peary, in Robeson Channel.

On May 8, Sir Martin Conway lectured to the Royal Geographical Society on his latest piece of exploring work in the Bolivian Andes. His survey was mostly confined to the western slopes of the Cordillera, "the backbone of Bolivia," and he hopes on his next visit to make an equally careful survey of the eastern slope. He gave some striking illustrations of the power of rivers and glaciers to eat their way backwards through vast mountains—in one instance a tributary of the Beni River, which flows into the Amazon and so into the Atlantic, having actually eaten its way back, clean through the Cordillera, and so drained a portion of the western slope of the range into the Atlantic. Sir Martin stated that the whole range was highly mineralised, but of the distribution of the minerals he could not say much. Gold was found at several points, chiefly on the east side of the range. Just below the snowy mass of Cacaaca on the west there is a really enormous vein of tin, while antimony, cobalt, and, he believed, platinum had been found in different parts. Subsequently Sir Martin Conway climbed Aconcagua, but his ascent was not a scientific, merely a sporting expedition.

The *Scientific American* gives a record of slaughter which, if authentic, is not without interest. It is to the effect that on Prince Schwarzenberg's preserves in Bohemia 106,604 wild animals were killed during last season,—including 200 deer, 250 boars, 27,000 hares, 39,000 grouse, and 6000 wild geese and ducks.

An edge of the seamy side of the collecting mania was recently exposed in Paris by the detection of an "egg-forger," who "made fly-catchers' eggs into those of the silk tail, and ducks' eggs into those of falcons, and larks' eggs into nightingales." A penguin's egg was made—not exactly out of nothing, but out of plaster of Paris and the like. As the counterfeits are almost indistinguishable, they would serve most purposes very well, and one almost wishes prosperity to the crime.

In a recent number of *La Nature*, Mr. Henry Castrey gives an analysis of the manna of the desert (*Canona esculenta*), which appears abundantly on the sand after rain, sometimes in great heaps. The analysis shows the following composition:—Water, 16 per cent.; nitrogenous matter, 14 per cent.; non-nitrogenous matter, 29 per cent.; carbohydrates, 32 per cent.; fat, 4 per cent.; mineral matter, 5 per cent.

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